Founded by G. Stanley Hall in 1891, reorganized by Carl Murchison in 1925

JOURNAL OF GENETIC PSYCHOLOGY

Child Behavior, Animal Behavior, and Problems of Aging

CARL MURCHISON

LOUISE BATES AMES
Gesell Institute of Child Development

JOHN E. ANDERSON
University of Minnesota

NANCY BAYLEY
Nat. Institutes of Health

JAMES E. BIRREN
Nat. Institutes of Health

WILLIAM E. BLATZ
University of Toronto

S. K. BOSE
University of Calcutta

CHARLOTTE BÜHLER
Univ. Southern California

CYRIL BURT
University of London

EWALD W. BUSSE
Duke University

LEONARD CARMICHAEL
Smithsonian Institution

WAYNE DENNIS
Brooklyn College

SANTE DE SANCTIS
R. Università di Roma

WILMA T. DONAHUE
University of Michigan

ROBERT J. HAVIGHURST
University of Chicago

WILLIAM HEALY
Judge Baker Foundation

JOHN E. HORROCKS
Ohio State University

J. McV. HUNT
University of Illinois

WENDELL E. JEFFREY
University of California

ARTHUR T. JERSILD
Columbia University

BUFFORD JOHNSON
Johns Hopkins University

HAROLD E. JONES
University of California

TRUMAN L. KELLEY
Harvard University

WILLIAM KESSEN
Yale University

ROBERT W. KLEEMEIER
Washington University

HEINRICH KLÜVER
University of Chicago

RONALD LIPPITT
University of Michigan

NORMAN L. MUNN
University of Adelaide

BERNICE L. NEUGARTEN
University of Chicago

TORAO OBONAI
Tokyo University

YOSHIKAZU OHWAKI
Tohoku University, Japan

HENRI PIÉRON
Université de Paris

ARTHUR J. RIOPELLE
Delta Regional Primate Research Center

ROBERT R. SEARS
Stanford University

NATHAN W. SHOCK
Baltimore City Hospitals

HAROLD W. STEVENSON
University of Minnesota

GEORGE D. STODDARD
University of Illinois

GEORGE G. THOMPSON
Ohio State University

C. J. WARDEN
Columbia University

A. T. WELFORD
Cambridge University

If this space should be unstamped, this is the regular library edition. But if this space is stamped with a designating title, this is a special edition, sold under the restrictions of a bilateral contract, and may not be resold for a period of five years from date of publication.

VOLUME 102

1963

Copyright, 1963, by The Journal Press
Provincetown, Massachusetts, U. S. A.

Entered as second-class matter May 11, 1937, at the post-office at Provincetown, Mass., under the Act of March 3, 1879
Second-class postage paid at Provincetown, Mass.

AUTHOR INDEX

TABLE OF CONTENTS

Journal of Genetic Psychology

CARL MURCHISON

Quarterly, published in March, June, September, and December. Devoted to child behavior, animal behavior, and the problems of aging. Manuscripts may be sent to any member of the Editorial Board, or may be sent directly to the general editorial office. All subscriptions and business communications should be sent directly to The Journal Press. Two volumes annually. Per annum, $20.00; per volume, $15.00; single numbers, $7.50. Complete sets from 1891 at $15.00 per volume, plus transportation.

Journal of General Psychology

CARL MURCHISON

Quarterly, published in January, April, July, and October. Devoted primarily to experimental, theoretical, clinical, and historical psychology. Manuscripts may be sent to any member of the Editorial Board, or may be sent directly to the general editorial office. All subscriptions and business communications should be sent directly to The Journal Press. Two volumes annually. Per annum, $20.00; per volume, $15.00; single numbers, $7.50. Complete sets from 1927 at $15.00 per volume, plus transportation.

Journal of Social Psychology

CARL MURCHISON

Bimonthly, beginning with February. National, group, cultural, racial, and differential psychology. Manuscripts may be sent to any member of the Editorial Board, or may be sent directly to the general editorial office. All subscriptions and business communications should be sent directly to The Journal Press. Bimonthly, three volumes per year; per annum, $30.00; per volume, $15.00; single numbers, $7.50. First number is dated February, 1930. Complete sets from 1930 at $15.00 per volume, plus transportation.

Each author will receive 100 unbound reprints gratis. Additional reprints may be purchased at a nominal cost when the author returns page-proof.

THE JOURNAL PRESS
2 Commercial Street
Provincetown, Massachusetts
U. S. A.

Club Rate For Five International Psychological Journals

	PER ANNUM
THE JOURNAL OF GENETIC PSYCHOLOGY . . . . (Quarterly, two volumes per year)	$20.00
GENETIC PSYCHOLOGY MONOGRAPHS . . . . (Quarterly, two volumes per year)	$20.00
THE JOURNAL OF GENERAL PSYCHOLOGY . . . . (Quarterly, two volumes per year)	$20.00
THE JOURNAL OF SOCIAL PSYCHOLOGY . . . . (Bimonthly, three volumes per year)	$30.00
THE JOURNAL OF PSYCHOLOGY . . . . (Quarterly, two volumes per year)	$20.00
TOTAL	$110.00

TEACHERS AND STUDENTS EDITION, *Restricted Sale* $30.00

The *Teachers and Students Edition* is open to any individual psychologist, teacher, student, or physician but requires an agreement that the edition will not be offered for sale till after five years from publication and an agreement that the edition will not be substituted for an institutional subscription.

The *"Small-Library" Edition* is discontinued.

THE JOURNAL PRESS
2 Commercial Street
Provincetown, Massachusetts
U. S. A.

Genetic Psychology Monographs

CARL MURCHISON

Quarterly: February, May, August, November. Two volumes per year. Child behavior, animal behavior, and the problems of aging. Each number one or more complete researches. Manuscripts may be sent to any member of the Editorial Board, or may be sent directly to the general editorial office. All subscriptions and business communications should be sent directly to The Journal Press. Two volumes annually. Per annum, $20.00; per volume, $15.00; single numbers, $7.50. Complete sets from 1926 at $15.00 per volume, plus transportation.

NOTICE. Once more we offer free publication for certain selected monographs. Authors will be charged for cuts and expensive tables, but there will be no page charge for the first 50 pages. For all pages above 50 there will be a charge of $10.00 per page. Two hundred reprints of each monograph will be supplied free of charge, but there will be nominal charges for such things as vitas, special covers, or special title pages.

Genetic Psychology Monographs *(continued)*

VOLUME 1—1926

1. Performance tests for children of pre-school age—R. Stutsman
2. An experimental study of the eidetic type—H. Klüver
3 & 4. A study of natio-racial mental differences—N. D. M. Hirsch
5. A psychological study of juvenile delinquency by group methods—J. W. Bridges and K. M. B. Bridges
6. The influence of puberty praecox on mental growth—A. Gesell

VOLUME 2—1927

1 & 2. The mind of a gorilla—R. M. Yerkes
3. The role of eye-muscles in the expression of the emotions—K. Dunlap
4. Family similarities in mental-test abilities—R. H. Willoughby
5. Coördination in the locomotion of infants—L. H. Burnside
6. The mind of a gorilla: Part II. Mental development—R. M. Yerkes

VOLUME 3—January-June, 1928

1. An experimental study of the olfactory sensitivity of the white rat—J. R. Liggett
2. A photographic study of eye movements in reading formulae—M. A. Tinker
3. An experimental study of the East Kentucky mountaineers—N. D. M. Hirsch
4. Responses of foetal guinea pigs prematurely delivered—G. T. Avery
5. Objective differentiation between three groups in education (teachers, research workers, and administration)—M. B. Jensen
6. The effect of segregation on the sex behavior of the white rat as measured by the obstruction method—M. Jenkins

VOLUME 4—July-December, 1928

1. Observation and training in the fundamental habits in young children—E. A. Bott, W. E. Blatz, N. Chant, and H. Bott
2 & 3. Determination of a content of the course in literature of a suitable difficulty for junior and senior high school students—M. C. Burch
4 & 5. Methods for diagnosis and treatment of cases of reading disability—M. Monroe (*foreword by Samuel T. Orton*)
6. The relative effectiveness of lecture and individual reading as methods of college teaching—E. B. Greene

VOLUME 5—January-June, 1929

1. The age factor in animal learning: I. Rats in the problem box and the maze—C. P. Stone
2. The effect of delayed incentive on the hunger drive in the white rat—E. L. Hamilton
3. Which hand is the eye of the blind?—J. M. Smith
4. The effect of attitude on free word association-time—A. G. Ekdahl
5. The localization of tactual space: A study of average and constant errors under different types of localization—L. E. Cole
6. The effect of gonadectomy, vasotomy, and injection of placental and orchic extracts on the sex behavior of the white rat—H. Thomson

VOLUME 6—July-December, 1929

1. Learning and growth in identical infant twins: An experimental study by the method of co-twin control—A. Gesell and H. W. Nissen
2. The age factor in animal learning: II. Rats in a multiple light discrimination box and a difficult maze—C. P. Stone
3. The acquisition and interference of motor habits in young children—E. McGinnis
4. A vocational and socio-educational survey of graduates and non-graduates of small high schools of New England—A. D. Mueller
5 & 6. A study of the smiling and laughing of infants in the first year of life—R. W. Washburn

VOLUME 7—January-June, 1930

1. Tensions and emotional factors in reaction—E. Duffy
2. Teacher influence on class achievement: A study of the relationship of estimated teaching ability to pupil achievement in reading and arithmetic—H. R. Taylor
3 & 4. A study of the effect of inverted retinal stimulation upon spatially coördinated behavior—P. H. Ewert
5. Mental development of children with lesion of the central nervous system—E. Lord
6. An experimental study upon three hundred school children over a six-year period—N. D. M. Hirsch

VOLUME 8—July-December, 1930

1. The amount and nature of activities of newborn infants under constant external stimulating conditions during the first ten days of life—O. C. Irwin
2. Race and social differences in performance tests—S. D. Porteus, D. M. Dewey, and R. G. Bernreuter
3. Language and growth: The relative efficacy of early and deferred vocabulary training—L. C. Strayer
4. Eye-movements and optic nystagmus in early infancy—J. M. McGinnis
5 & 6. Reactions of kindergarten, first-, and second-grade children to constructive play materials—L. Farwell

VOLUME 9—January-June, 1931

1 & 2. The status of the first-born with a special reference to intelligence—H. H. Hsiao
3 & 4. An experimental study of bright, average and dull children at the four-year mental level—H. P. Davidson
5. An historical, critical, and experimental study of the Seashore-Kwalwasser test battery—P. R. Farnsworth
6. A comparison of difficulty and improvement in the learning of bright and dull children in reproducing a descriptive selection—F. T. Wilson

VOLUME 10—July-December, 1931

1. A comparative study of a group of southern white and negro infants—M. B. McGraw
2 & 3. An experimental study of prehension in infants by means of systematic cinema records—H. M. Halverson
4. The limits of learning ability in kittens—A. M. Shuey
5 & 6. The effect of habit interference upon performance in maze learning—O. W. Alm

VOLUME 11—January-June, 1932

1. General factors in transfer of training in the white rat—T. A. Jackson
2. The effect of color on visual apprehension and perception—M. A. Tinker
3. The reliability and validity of maze experiments with white rats—R. Leeper
4. A critical study of two lists of best books for children—F. K. Shuttleworth
5 & 6. Measuring human energy cost in industry: A general guide to the literature—R. M. Page

VOLUME 12—July-December, 1932

1. Family resemblances in verbal and numerical abilities—H. D. Carter
2. The development of fine prehension in infancy—B. M. Castner
3 & 4. The growth of adaptive behavior in infants: An experimental study at seven age levels—H. M. Richardson
5 & 6. Differential reactions to taste and temperature stimuli in newborn infants—K. Jensen

VOLUME 13—January-June, 1933

1. A critique of sublimation in males: A study of forty superior single men—W. S. Taylor
2. A study of the nature, measurement, and determination of hand preference—H. L. Koch, *et al.*
3. The growth and decline of intelligence—H. E. Jones and H. S. Conrad
4. The relation between the complexity of the habit to be acquired and the form of the learning curve in young children—M. L. Mattson
5. Eating habits in relation to personality developments in two-, and three-year-old children: A study of sixty-nine children in two nursery schools—A. A. Eliot
6. Coördinating mechanisms of the spinal cord—O. C. Ingebritsen

Genetic Psychology Monographs *(continued)*

VOLUME 14—July-December, 1933

1. Mental growth during the first three years: A developmental study of sixty-one children by repeated tests—N. BAYLEY
2. A study of triplets: including theories of their possible genetic relationships—F. N. ANDERSON AND N. V. SCHIEDEMANN
3. The objective measurement of emotional reactions—H. V. GASKILL
4. Development of behavior in the fetal cat—J. D. CORONIOS
5. A study of certain language development of children in grades four to twelve, inclusive—L. L. LABRANT
6. The effect of early delayed practice in memory and motor performance studied by the method of co-twin control—J. R. HILGARD

VOLUME 15—January-June, 1934

1. Studies in the psychology of tone and music—P. R. FARNSWORTH
2. Motor learning of children in equilibrium in relation to nutrition—E. L. BEEBE
3. Discrimination limens of pattern and size in the goldfish *Carassius auratus*—J. B. ROWLEY
4. Limits of learning in the white rat and the guinea pig—B. F. RIESS

5 & 6. The limits of learning ability in rhesus monkeys—H. A. FJELD

VOLUME 16—July-December, 1934

1. A statistical study of ratings on the California behavior inventory for nursery school children—H. S. CONRAD
2. An eye-movement study of objective examination questions—A. FRANDSEN
3. An experimental study of constitutional types—O. KLINEBERG, S. E. ASCH, AND H. BLOCK
4. The development of a battery of objective group tests of manual laterality with the results of their application to 1,300 children—W. N. DUROST

5 & 6. An experimental study in the prenatal guinea-pig of the origin and development of reflexes and patterns of behavior in relation to the stimulations of specific receptor areas during the period of active fetal life—L. CARMICHAEL

VOLUME 17—January-December, 1935

1. Organization of behavior in the Albino rat—R. L. THORNDIKE
2. Brightness discrimination in the rhesus monkey—M. P. CRAWFORD
3. The limits of learning ability in cebus monkeys—A. M. KOCH
4. Nature-nurture and intelligence—A. M. LEAHY
5. On intelligence of epileptic children—E. B. SULLIVAN AND L. GAHAGAN
6. A study of the play of preschool children by an unobserved observer—D. L. COCKEREL

VOLUME 18—January-December, 1936

1. Sex differences in variational tendency—Q. MCNEMAR AND L. M. TERMAN
2. The process of learning to dress among nursery-school children—C. B. KEY, M. R. WHITE, A. B. HIENEY, M. P. HONZIK, AND D. ERWIN
3. A study of the present social status of a group of adults who, when they were in the elementary schools, were classified as mentally deficient—W. BALLER
4. The influence of specific experience upon mental organizations—A. ANASTASI

5 & 6. Studies in aggressiveness—L. BENDER, S. KEISER, AND P. SCHILDER

VOLUME 19—January-December, 1937

1. Psychological bases of self-mutilation—C. DABROWSKI
   Masculine temperament and secondary sex characteristics: A study of the relationship between psychological and physical measures of masculinity—H. GILKINSON
2. A psychological study of forty unmarried mothers—R. D. NOTTINGHAM
   Behavior problems in the children of psychotic and criminal parents—L. BENDER
3. Domination and integration in the social behavior of young children in an experimental play situation—H. H. ANDERSON
4. The sequential patterning of prone progression in the human infant—L. B. AMES

VOLUME 20—January-December, 1938

1. The relationship between characteristics of personality and physique in adolescents—P. S. DE Q. CABOT
2. Behavior problems of elementary school: A description and comparative study—I. YOUNG-MASTEN
   Graphic representation of a man by four-year-old children in nine prescribed drawing situations—P. E. GRIDLEY
3. Differences between two groups of adult criminals—R. S. TOLMAN
4. A comparative study by means of the Rorschach method of personality development in twenty pairs of identical stimuli—W. E. GAULT
   Individual differences in the facial expressive behavior of pre-school children: A study by the time-sampling method—C. SWAN

VOLUME 21—January-December, 1939

1. An experimental analysis of "level of aspiration"—R. GOULD
2. Some light on the problem of bilingualism as found from a study of the progress in mastery of English among pre-school children of non-American ancestry in Hawaii—M. E. SMITH
3. Domination and social integration in the behavior of kindergarten children and teachers—H. H. ANDERSON
   The capacity of the rhesus and cebus monkey and the gibbon to acquire differential response to complex visual stimuli—W. E. GAULT
4. The social-sex development of children—E. H. CAMPBELL

VOLUME 22—January-December, 1940

1. Measuring human relations: An introduction to the study of the interaction of individuals—E. D. CHAPPLE
2. Aggressive behavior in young children and children's attitudes toward aggression—M. D. FITE
3. Student attitudes toward religion—E. NELSON
   The prediction of the outcome-on-furlough of dementia praecox victims—J. S. JACOB
   Significant characteristics of pre-school children as located in Conrad inventory—K. H. READ
4. Learning by children at noon-meal in a nursery school: Ten "good" eaters and ten "poor" eaters—J. B. MCKAY, E. B. WARING, AND P. J. KRUSE
   Studies in the interpretation of play: I. Clinical observation of play disruption in young children—E. H. ERIKSON

VOLUME 23—January-June, 1941

1. An analysis of certain variables in a developmental study of language—F. M. YOUNG
   An analysis of the mental factors of various age groups from nine to sixty—B. BALINSKY
2. Factors influencing performance on group and individual tests of intelligence: I. Rate of work—M. W. BENNETT
   Individual differences in apperceptive reaction: A study of the response of preschool children to pictures—E. W. AMEN

VOLUME 24—July-December, 1941

1. Twins *T* and *C* from infancy to adolescence. A biogenetic study of individual differences by the method of co-twin control—A. GESELL AND H. THOMPSON
   Finger nail-biting: its incipiency, and amelioration—A. L. BILLIG
   An experimental study of the factors of maturation and practice in the behavioral development of the embryo of the frog, *Rana pipiens*—A. FROMME
2. The Fels child behavior scales—T. W. RICHARDS AND M. P. SIMONS
   Measurement of the size of general English vocabulary through the elementary grades and high school—M. K. SMITH
   Stereotypes in the field of musical eminence—P. R. FARNSWORTH

VOLUME 25—January-June, 1942

1. A study of factors determining family size in a selected professional group—J. C. FLANAGAN
   A genetic study of geometrical-optical illusions—SISTER A. WALTERS
   Interpretation of behavior-ratings in terms of favorable and unfavorable deviations: A study of scores from the Read-Conrad Behavior Inventory—K. H. READ AND H. S. CONRAD
2. Are there any innate behavior tendencies?—J. B. SCHOOLLAND
   An investigation of the intelligibility of the speech of the deaf—C. V. HUDGINS AND F. C. NUMBERS

Genetic Psychology Monographs *(continued)*

VOLUME 26—July-December, 1942

1. The critical frequency limen for visual flicker in children between the ages of 6 and 18—V. L. Miller
   Some factors determining handedness in the white rat—K. L. Wentworth
2. Motivation and behavior—E. Frenkel-Brunswik

VOLUME 27—January-June, 1943

1. Comparison of children's personality traits, attitudes, and intelligence with parental occupation—N. R. Maddy
2. A comparative study of mental functioning patterns of problem and non-problem children seven, eight, and nine years of age—M. L. Pignatelli

VOLUME 28—July-December, 1943

1. Separation anxiety in young children: A study of hospital cases—H. Edelston
2. Correlates of vocational preferences—W. A. Bradley, Jr.

VOLUME 29—January-June, 1944

1. Mental changes after bilateral prefrontal lobotomy—S. D. Porteus and R. D. Kepner
2. A twin-controlled experiment on the learning of auxiliary languages—B. Price, W. J. Kostir, and W. M. Taylor

VOLUME 30—July-December, 1944

1. A method of administering and evaluating the thematic apperception test in group situations—R. M. Clark
2. A study of anxiety reactions in young children by means of a projective technique—R. Temple and E. W. Amen

VOLUME 31—January-June, 1945

1. The evolution of intelligent behavior in rhesus monkeys—B. Weinstein
2. Perceptual behavior of brain-injured, mentally defective children: An experimental study by means of the Rorschach technique—H. Werner

VOLUME 32—July-December, 1945

1. A clinical study of sentiments: I.—H. A. Murray and C. D. Morgan
2. A clinical study of sentiments: II.—H. A. Murray and C. D. Morgan

VOLUME 33—January-June, 1946

1. Interpretation of spontaneous drawings and paintings—T. S. Waehner
   Preference for sex symbols and their personality correlates—K. Franck
2. Outstanding traits in a selected college group—F. L. Wells and W. L. Woods

VOLUME 34—July-December, 1946

1. The relation of emotional adjustment to intellectual function—J. L. Despert and H. O. Pierce
   The smiling response—R. A. Spitz
2. Finger-painting and personality diagnosis—P. J. Napoli

VOLUME 35—January-June, 1947

1. The thematic apperception technique in the study of culture-personality relations—W. E. Henry
2. A continuation study of anxiety reactions in young children by means of a projective technique—M. Dorkey and E. W. Amen
   A study of the vocational interest trends of secondary school and college women—A. M. Cawley

VOLUME 36—July-December, 1947

1. Maze test validation and psychosurgery—S. D. Porteus and H. N. Peters
2. Diagnostic implications of Rorschach's Test in case studies of mental defectives—I. Jolles

VOLUME 37—January-June, 1948

1. The radio daytime serial: A symbolic analysis—W. L. Warner and W. E. Henry
   The relation of personality characteristics and response to verbal approval in a learning task—G. L. Grace
2. The mechanism of vision: XVIII. Effects of destroying the visual "associative areas" of the monkey—K. S. Lashley
   A study of the relationship between handwriting and personality variables—P. Castelnuova-Tedesco

VOLUME 38—July-December, 1948

1. Modern language learning: The intensive course as sponsored by the United States Army, and implications for the undergraduate course of study—M. Lind
   Conflict: A study of some interactions between appetite and aversion in the white rat—M. A. Tolcott
2. A study of certain formal psycho-social aspects of fantasy production in schizophrenia as revealed by performance on the Make a Picture Story (Maps) Test—E. S. Shneidman
   A study of the transmission of authority in the family—H. L. Ingersoll

VOLUME 39—January-June, 1949

1. A study of the psychoanalytic theory of psychosexual development—G. S. Blum
   The assessment of parental attitudes in relation to child adjustment—E. J. Shoben, Jr.
2. Qualitative differences in the vocabulary responses of normals and abnormals—H. Feifel
   The relative effectiveness of motion and still pictures as stimuli for eliciting fantasy stories about adolescent-parent relationship—P. E. Eiserer
   The organization of heredity maze-brightness and maze-dullness—L. V. Searle

VOLUME 40—July-December, 1949

1. An experimental study of what young school children expect from their teachers—B. Biber and C. Lewis
   A study of the relative effects of age and of test difficulty upon factor patterns—H. A. Curtis
   A projective experiment using incomplete stories with multiple choice endings—J. K. Seaton
2. Effects of sex role and social status on the early adolescent personality—E. Milner
   Social perceptions and attitudes of children—M. Radke, H. Trager, and H. Davis

VOLUME 41—January-June, 1950

1. Some psychological and educational aspects of pediatric practice: A study of well-baby clinics—L. H. Blum
   One-trial learning in the domestic rat—B. B. Hudson
   An introduction to the principles of scientific psychoanalysis—A. Ellis
2. Awareness of racial differences by preschool children in Hawaii—D. V. Springer
   Children's evaluation of teacher-approved and teacher-disapproved behavior—S. L. Witryol
   The relationship between level of vocational aspiration and certain personal data—J. Stubbins

VOLUME 42—July-December, 1950

1. Personality patterns of suicidal mental hospital patients—N. L. Farberow
   Sex-role identification in young children in two diverse social groups—M. Rabban
2. A study of the influence of the social field on individual behavior: As revealed in the expression of hostility and warmth by neurotics and paranoid schizophrenics in discussion group situations—D. Shapiro
   An experimental study of avoidance—R. F. Hefferline

VOLUME 43—January-June, 1951

1. A study of copying ability in children—E. A. Townsend
   Prestige motivation of gifted children—D. P. Ausubel
2. A psychological study of physical scientists—A. Roe

VOLUME 44—July-December, 1951

1. The organization of hostility controls in various personality structures—S. Fisher and E. Hinds
   Children and radio: A study of listeners and non-listeners to various types of radio programs in terms of selected ability, attitude, and behavior measures—E. A. Ricciuti
2. Quantitative expression in young children—W. E. Martin
   The use of magnetic devices in the collection and analysis of the preverbal utterances of an infant—A. W. Lynip

VOLUME 45—January-June, 1952

1. Japanese-American personality and acculturation—W. Caudill
2. A statistical study of the Freudian theory of levels of psychosexual development—C. A. Barnes
   Personality characteristics of selected disability groups—D. N. Wiener

Genetic Psychology Monographs *(continued)*

VOLUME 46—July-December, 1952

1. The relationship of social status, intelligence, and sex of 10- and 11-year-old children to an awareness of poverty—F. J. Estvan
   An empirical study of the castration and Oedipus complexes—S. Friedman
2. The relationship between projective test scoring categories and activity preferences—M. M. Schwartz
   A comparison of formal and content factors in the diagnostic testing of schizophrenia—M. Sherman

VOLUME 47—January-June, 1953

1. Ability and accomplishment of persons earlier judged mentally deficient—D. C. Charles
   Variations in the consistency of the behavioral meaning of personality test scores—M. Kornreich
   Some child-rearing antecedents of aggression and dependency in young children—R. R. Sears, *et al.*
   Symptom correlates for descriptive diagnosis—J. R. Wittenborn, *et al.*

VOLUME 48—July-December, 1953

1. Age and mental abilities: A longitudinal study—W. A. Owens, Jr.
   The development of a personality questionnaire for drinkers—P. J. Hampton
   Personality and physical disease: A test of the Dunbar hypothesis applied to diabetes mellitus and rheumatic fever—D. H. Crowell
2. Socio-economic contrasts in children's peer culture prestige values—B. Pope
   A critical review of the stability of social acceptability scores obtained with the partial-rank-order and the paired-comparison scales—S. A. Witryol and G. G. Thompson
   A study of the effects of color in Rorschach responses—G. G. Brody

VOLUME 49—January-June, 1954

1. Factors underlying major reading disabilities at the college level—J. A. Holmes
   Parent behavior toward first and second children—J. K. Lasko
2. Social-status and intelligence: An experimental study of certain cultural determinants of measured intelligence—E. A. Haggard
   Certain determinants and correlates of authoritarianism—S. Siegel
   Personalities in faces: I. An experiment in social perceiving—P. F. Secord, W. F. Dukes and W. Bevan

VOLUME 50—July-December, 1954

1. A study of the relationship between play patterns and anxiety in young children—E. W. Amen and N. Renison
   Operational explorations of the conceptual self system and of the interaction between frames of reference—M. Edelson and A. E. Jones
   Problem solving: A statistical description of some relationships between organismic factors and selected response measures—N. A. Fattu, E. Kapos and E. V. Mech
2. The relation of cortical potentials to perceptual functions—C. Chyatte
   The import for clinical psychology of the use of tests devised from theories about infantile sexuality and adult character—D. W. Miles
   Measuring personality in developmental terms: The P.P.S.—M. H. Krout and J. K. Tabin

VOLUME 51—January-June, 1955

1. Some relations between techniques of feeding and training during infancy and certain behavior in childhood—A. Bernstein
   The expression of personality in drawings and paintings—L. H. Stewart
2. Negative stereotypes concerning Americans among American-born children receiving various types of minority-group education—J. A. Fishman
   The Lincoln-Oseretsky motor development scale—W. Sloan

VOLUME 52—July-December, 1955

1. Some personality correlates of sex, sibling position, and sex of sibling among five- and six-year-old children—H. L. Koch
   A quantitative Rorschach assessment of maladjustment and rigidity in acculturating Japanese Americans—G. Devos
   Measurement of authoritarianism and its relation to teachers' classroom behavior—H. M. McGee
2. The formal aspects of schizophrenic verbal communication—B. Mirin
   A study in an aspect of concept formation with subnormal, average, and superior adolescents—H. N. Hoffman
   Traumatic avoidance learning: Acquisition and extinction in dogs deprived of normal peripheral autonomic function—L. C. Wynne and R. L. Solomon

VOLUME 53—January-June, 1956

1. As the psychiatric aide sees his work and problems—F. L. Wells, M. Greenblatt and R. W. Hyde
   An investigation of avoidance, anxiety, and escape behavior in human subjects as measured by action potentials in muscle—J. D. Brothers
   Spread of effect: A critical review—M. H. Marx
2. Stress, fantasy, and schizophrenia: A study of the adaptive processes—O. J. B. Kerner
   The attitude structure of the individual: A Q-study of the educational attitudes of professors and laymen—F. N. Kerlinger

VOLUME 54—July-December, 1956

1. A study of the personality differences between middle and lower class adolescents: The Szondi Test in culture-personality research—L. Rainwater
   The assessment of parental identification—S. W. Gray and R. Klaus
2. The influence of social context on impulse and control tendencies in preadolescents—G. H. Zuk
   Tender-mindedness versus tough-mindedness in psychology: A reexamination—H. Winthrop
   A method for the comparison of groups: A study in thematic apperception—L. C. Shaw and W. E. Henry

VOLUME 55—January-June, 1957

1. Academic performance and personality adjustments of highly intelligent college students—B. M. Horrall
   The use of the Vineland Social Maturity Scale in the planning of an educational program for non-institutionalized low-grade mentally deficient children—M. G. Gottsegen
2. The structure and origin of the anal character—H. Beloff
   Free expression of adolescents' interests—M. Amatora
   The role of mass media and the effect of aggressive film content upon children's aggressive responses and identification choices—R. S. Albert
   Interest in persons as an aspect of sex difference in the early years—E. W. Goodenough

VOLUME 56—July-December, 1957

1. Some stable response determinants of perception, thinking, and learning: A study based on the analysis of a single test—M. L. Simmel and S. Counts
   Potentials of age: An exploratory field study—S. L. Pressey
2. Tactile communication—L. K. Frank
   The use of a filmed puppet show as a group projective technique for children—M. R. Haworth
   The social competence of middle-aged people—R. J. Havighurst

VOLUME 57—January-June, 1958

1. Psychological and cultural problems in mental subnormality: A review of research—S. B. Sarason and T. Gladwin
2. Developmental aspects of discrimination in relation to adjustment—P. London
   Muscular tension as a response to psychological stress in rheumatoid arthritis and peptic ulcer—J. A. Southworth
   Frustration: Theory and experiment—R. Lawson and M. H. Marx

VOLUME 58—July-December, 1958

1. Emotional aspects of political behavior: The woman voter—E. M. Bennett and H. W. Goodwin
   The accuracy of self estimate: A measure of self-concept reality—R. M. Brandt
   Personality factors in social mobility: A study of occupationally mobile businessmen—J. C. Abegglen
2. Interaction between authoritarian and nonauthoritarian principals and teachers—P. Lambert
   Some factors related to the choice-status of ninety eighth-grade children in a school society—D. Elkins
   Some relationships between fantasy and self-report behavior—R. G. Calogeras

Genetic Psychology Monographs *(continued)*

VOLUME 59—January-June, 1959

1. Freshman Rorschachs and college performance—G. R. Schmeidler, M. J. Nelson, and M. Bristol
   Perceptual aspects of attributed movement—R. W. Coan
   Men and women: Personality patterns and contrasts—E. M. Bennett and L. R. Cohen
2. Personality factors in mothers of cerebral palsied children—G. Boles
   Separation and integrationism: A social-psychological analysis of editorial content in New York newspapers of three American minority groups—J. A. Fishman and G. S. Fishman
   Self, role, and satisfaction—A. L. Brophy

VOLUME 60—July-December, 1959

1. The constancy of personality ratings over two decades—R. D. Tuddenham
   Mother-son identification and vocational interest—L. H. Stewart
   A study of mother-child relationships in the emotional disorders of children—M. J. Rosenthal, M. Finkelstein, E. Ni, and R. E. Robertson
   On the trail of the wolf-children—W. F. Ogburn and N. K. Bose
2. Measuring the mental health of normal adults—R. F. Peck
   Parental identification in young children—W. Emmerich
   The problems of Jewish religious youth—B. M. Levinson

VOLUME 61—January-June, 1960

1. Identifying socially maladjusted school children—A. A. Adams
   Social interaction in an interracial nursery school—H. W. Stevenson and N. G. Stevenson
   Interests of pre-adolescent boys and girls—M. Amatora
   Educational and sex differences in the organization of abilities in technical and academic students in Colombia, South America—J. F. Filella
2. Some themes in the personalities of German men—L. Rainwater
   Right-left gradients in body image, body reactivity, and perception—S. Fisher
   Longitudinal survey of child Rorschach responses: Younger subjects two to 10 years—L. B. Ames
   Personality patterns related to occupational roles—M. Siegelman and R. F. Peck

VOLUME 62—July-December, 1960

1. The reading process: A descriptive, interdisciplinary approach—M. P. Langman
   Reactions to stress as a function of the level of intelligence—S. M. H. Zaidi
   Rorschach diagnosis by a systematic combining of content, thought process, and determinant scales—P. A. Bower, R. Testin, and A. Roberts
   Longitudinal survey of child Rorschach responses: Older subjects aged 10 to 16 years—L B. Ames
2. Twenty years of shock therapy in America, 1937-1956: An annotated bibliography—N. H. Pronko, R. Sitterly, and K. Berg
   The quantitative analysis of parent behavior toward psychotic children and their siblings—E. M. Donnelly

VOLUME 63—January-June, 1961

1. Make a sentence test: An approach to objective scoring of sentence completions—E. F. Borgatta
   Some aspects of the relationship between perception and motility in children—E. P. Rothman
   Some psychophysical aspects of mental illness in children—P. H. Berkowitz
   Conceptual thinking in schizophrenic children—G. Friedman
2. Some maternal influences on children's personality and character—J. C. Finney
   A study of concept formation in normals, mental defectives, and brain-damaged adults—R. W. Zaslow
   An investigation of trait relationships among six-year-old children—S. A. Avakian

VOLUME 64—July-December, 1961

1. Coping patterns of preschool children in response to intelligence test demands—A. Moriarty
   Studies of individual and paired interactional problem-solving behavior of rats: I. Solitary and social controls—A. Baron and R. A. Littman
2. Studies of role performance—J. H. Mann
   A psychological assesment of professional actors and related professions—R. Taft
   A cross-cultural study of menstrual taboos—W. N. Stephens
   The biological roots of creativity—H. Gutman

VOLUME 65—January-June, 1962

1. A Rorschach study of the development of personality structure in white and Negro children in a Southeastern community—A. C. Price
   Measuring personality patterns of women—J. Loevinger
   Home interests in early adolescence—M. Amatora
   Social and emotional adjustment during adolescence as related to the development of psychosomatic illness in adulthood—L. H. Stewart
2. A systematic study of interaction process scores, peer and self-assessments, personality and other variables—E. F. Borgatta
   Children's conceptions of the content and functions of the human body—E. Gellert

VOLUME 66—July-December, 1962

1. Ocular-manual laterality and perceptual rotation of literal symbols—I. Flescher
   Parental child-rearing attitudes and their correlates in adolescent hostility—S. B. Chorost
   Some explorations into the nature of anxieties relating to illness—P. R. Robbins
   Developmental-interactive aspects of hypnosis: some illustrative cases—J. R. Hilgard and E. R. Hilgard
2. Teaching a two-year-old to read: an experiment in early childhood learning—W. Fowler
   Achievement gains or losses during the academic year and over the summer vacation period: a study of trends in achievement by sex and grade level among students of average intelligence—K. M. Parsley, Jr. and M. Powell

VOLUME 67—January-June, 1963

1. Verbatim dialogue of a mother and child in therapy—C. E. Moustakas
   A study of self-concept: delinquent boys' accuracy in selected self-evaluations—W. E. Amos
   An integrating study of the factor structure of adult attitude-interests—R. B. Cattell and John Horn
   Social factors in mental disorders: a contribution to the etiology of mental illness—W. G. Cobliner

THE JOURNAL PRESS
2 Commercial Street
Provincetown, Massachusetts
U. S. A.

$20.00 per year
$15.00 per volume
Single Numbers $7.50

QUARTERLY
Two volumes per year

March, 1963
Volume 102, First Half

Founded by G. Stanley Hall in 1891, reorganized by Carl Murchison in 1925

THE JOURNAL OF GENETIC PSYCHOLOGY

Child Behavior, Animal Behavior, and Problems of Aging

If this space should be unstamped, this is the regular library edition. But if this space is stamped with a designating title, this is a special edition, sold

under the restrictions of a liberal contract, and may not be resold for a period of five years from the date of publication.

MARCH, 1963

(Manuscripts are printed in the order of final acceptance)

Copyright, 1963, by The Journal Press
Provincetown, Massachusetts, U. S. A.

Entered as second-class matter April 3, 1937, at the post-office at Provincetown, Mass., under the Act of March 3, 1879
Second-class postage paid at Provincetown, Mass.

The Journal of Genetic Psychology, 1963, **102**, 3-4.

DELAYED RECALL OF PREVIOUSLY MEMORIZED MATERIAL AFTER FIFTY YEARS*

Honolulu, Hawaii

MADORAH E. SMITH

A. INTRODUCTION AND PURPOSE

This report is a follow-up of two studies (1, 2) made over 10 and 26 years ago. In the first report (1) the method used, one of distributed practice and frequent reviews in the memorization of the 107 answers to the questions in the Westminster Shorter Catechism was explained in detail. Although the answers to all the questions were perfectly recited at one sitting 60 years ago before the child's thirteenth birthday, there was considerable incidental practice during the next 10 years of the earlier portion of the catechism. The latter part of the book received no such practice so its present recall can be considered to be after 60 years but the earlier portion after approximately 50 years. Aside from the attempts at repetition, 10 and 26 years ago, only the answers quoting the Bible, as in naming the Commandments, and the very first answer have received any even incidental practice.

When repetition of the answers was undertaken recently, some forgetting of previously recalled answers took place. As shown in the table, more answers

TABLE 1
RECORD OF NUMBER OF ANSWERS KNOWN IN

	1934	1950	1960
Remembered	54	53	41
Prompted once	44	39	32
Partly forgotten	9	15	34

were partly forgotten during the last 10 years than in the preceding 40 or 50 years. At least one cue was required for 66 answers as against 53 on the first trial; while 34 now needed more than one prompting as against nine on the first trial. However, on none of the three trials were all phrases of any answer completely forgotten.

Of the 54 perfectly remembered answers in 1934 only two were not recalled after a single cue was given; but of the 53 other answers, 21 again required but one cue and the rest two or more cues.

* Received in the Editorial Office on December 5, 1960.

In 1934, each answer, except the Commandments, was given a difficulty score of from zero to seven points based on length, lack of help from the number of words in the question that are repeated in its answer, and its place in the numerical order of the catechism. As stated above the direct quotations from the Bible had received some interim practice and these 11 answers were perfectly remembered each time. As before, a larger proportion of the answers with low difficulty scores were recalled. The average difficulty score of those perfectly remembered was 2.7; of those remembered in 1934 but now requiring a single prompting, the score was 2.8; of those requiring such prompting both then and now, the score was 4.2, while those requiring more prompting had an average score of 5.0.

Of the 22 answers in the last quintile, which had had no practice during 60 years, only two of the shortest were remembered and three others with but a single cue. But of the 22 in the first quintile, which had received considerable practice until 50 years ago, 14 were still perfectly remembered and only three of the longest required more than a single prompting.

B. Conclusion

Forgetting was more rapid during the last 10 years than during the preceding 30 or 40 years; that is, after 63 years of age than before that age. The answers forgotten were the more difficult, those not overlearned in childhood and that had received no incidental practice during the 60 years after first completing the memorization of the Westminster Shorter Catechism.

References

1. Smith, M. E. Delayed recall of previously memorized material after twenty years. *J. Genet. Psychol.*, 1935, 477-481.
2. Smith, M. E. Delayed recall of previously memorized material after forty years. *J. Genet. Psychol.*, 1951, **79**, 377-378.

Madorah E. Smith
3221 Waialae Avenue
Honolulu, 16, Hawaii

The Journal of Genetic Psychology, 1963, **102**, 5-18.

THE ONTOGENESIS OF CHOICE BEHAVIOR IN PROBABILITY AND SEQUENTIAL PROGRAMS* [1] [2]

Norristown State Hospital

ALFRED E. GOLDMAN AND JOSEPH DENNY

A. INTRODUCTION AND PURPOSE

This study is concerned with the ontogenesis of choice behavior and endeavors to uncover some of the processes involved in this development.

The theoretical context of this study is that of a comparative developmental psychology (12). It proceeds from the notion that ontogenesis is characterized by qualitatively different stages, rather than being merely quantitatively distinguishable. We adhere, in this investigation, to the belief, stated most broadly by Heinz Werner (12), that the nature of human growth may be best understood through exploration for organizational stages. That this approach is a fruitful one has already been demonstrated by extensive research on the development of motoric, emotional, perceptual, mnemonic, conceptual, and linguistic functioning (13). To understand the development of intelligent choice behavior, then requires seeking for processes which appear to characterize qualitatively different modes of functioning.

This approach is not consistent with those theoretical orientations which view choice behavior, and indeed all human learning phenomena, as reduceable to a single process. That is, we do not conceive of any one process as being paradigmatic of the whole range of human learning. A view which reduces all learning to a single process, different only in quantitative achievement is agenetic. It conceives of the adult as having available more response alternatives, or a greater variety of stimulus-response connections than the child. A genetic point of view conceives of the adult and child as utilizing different processes which are not necessarily distinguishable in terms of efficiency or achievement.

* Received in the Editorial Office on December 9, 1960.

[1] The authors wish to acknowledge their indebtedness for the cooperation and support given this research by Dr. Arthur P. Noyes, former Superintendent, Norristown State Hospital, and by Dr. William P. Camp, present Superintendent, Norristown State Hospital.

[2] This research was supported, in part, by the United States Air Force under Contract No. AF 41 (657)-118, monitored by Operator Laboratory, Field Unit No. 1, Air Force Personnel and Training Research Center, Lackland Air Force Base, San Antonio, Texas.

The present experiment investigates performance in two learning situations as a function of age—probability learning and sequential learning. These differ primarily in the structure of the reward sequences. The aim in both situations is to maximize the number of rewards received. Both tasks also require guessing which of two lights will go on in the next trial, on the basis of prior outcomes.

In the probability task a prearranged, random left-right order is established so that of two alternatives, one alternative is "correct," i.e., gives a valued outcome, 75 per cent of the time, while the other alternative is "correct" 25 per cent of the time. "Solution" to this problem, that is, maximizing the number of correct guesses, requires selection, on every trial, of the alternative which has a potential of 75 per cent reward.

In the sequential task the valued outcomes are prearranged according to some regular pattern or sequence. Maximizing the number of rewards involves discovery of that sequence.

The difference between these two kinds of learning tasks suggested that they could be distinguished in terms of developmental level, i.e., that the sequential learning task required a genetically more advanced process for its solution than the probability task. Sequential learning would appear to demand, or at least permit, greater cognitive intervention in the solution process than probability learning. Our hypotheses, then, are: (*a*) performance in a probability learning task will not vary as a function of age; and (*b*) performance in a sequential-learning task will improve as age increases.

B. Method

Comparison of the development of two kinds of learning makes several demands on the technique used. First, to limit whatever might be contributed by the technique itself to differences in performance between the two tasks it seemed advantageous to use the same apparatus and similar goals on both tasks.

Secondly, a developmental study requires that the task be sufficiently interesting to a wide age range and yet simple enough so that very young children could understand the instructions. Also, since a wide age range was sampled, a technique was required which could deliver tokens which could then be traded in for rewards of the *S*'s own choice. This method provides different rewards that are sufficiently valued by each *S* to maintain interest throughout the experiment.

Lastly, to limit the role of the *E* himself a technique was sought which would permit the use of non-verbal signals in providing reinforcement and other information to the *S*.

A binary choice apparatus, devised especially for this experiment appeared to meet these needs.[4]

1. *Apparatus*

The apparatus has three sides, in front of which sits the *S* and behind which, completely hidden from the *S*'s view, is seated the *E*. The front panel of the binary choice apparatus is 28″ high by 38″ wide; at the bottom of the front panel is a switch panel 6″ away from the front panel and projecting toward the *S* at an angle of 45°. The two switches are located 9″ in from each side of the lower panel and about 7″ above each switch is a red light, 4″ above and between the two red lights is a green light.

Each of the *S*'s switches is connected in series to a light on the back of the apparatus indicating the response to the *E*. *E* lights the green light and either of the two red lights by multiple-throw switches.

Six inches from the right side of the front panel is an opening of a 1″ diameter chute that leads from the *E*'s to the *S*'s side of the apparatus and into a square clear plastic container. This is used to reward the *S* by dropping marbles through the chute into the transparent box. The box holds about a hundred marbles. A second opening, 2″ in from the right side of the front panel, is used when the *S* is required to deposit marbles for incorrect choices that he has made. These marbles are collected on the examiner's side of the apparatus.

Use of this apparatus appeared to offer the following advantages: (*a*) it can be programmed so as to permit study of different learning processes; (*b*) by use of tokens which can be traded in for rewards, the device can be used with a wide variety of *S*s; (*c*) use of non-verbal signals and reinforcers, e.g., lights and reward chute and box, reduces whatever variance the *E* may introduce into the performance; and (*d*) bright colors and use of marbles, tokens and toy rewards suggest a "game" to the children rather than a test of their ability.

2. *Subjects*

*S*s were 240 boys from a public grade school in the suburbs of Norristown, Pennsylvania.[5] Since the study was designed to explore developmental

---

[4] We are indebted to Dr. E. Galanter, University of Pennsylvania, for his help in the design of both the apparatus and the procedure.

[5] We wish to extend our thanks to Miss Cynthia Welder, Supervisor of Special

patterns, a wide range of age levels were used, with the largest proportion of *S*s at the lower end, since it was at these earlier levels that the greatest changes were anticipated. The following age levels were sampled: 5-6, 7-8, 9-10, 11-12, 14-15. To reduce sampling error all of the boys in the age groups used were tested except those who were out of school for extended periods of time due to illness. These age groupings encompassed kindergarten and Grades 1, 2, 4, 6, and 9. *S*s were alternately assigned to either of the two groups as they appeared at the testing room.

3. *General Procedure*

*S*s were sent one at a time to the experimental room. Special attention was given to establishing rapport with each child. He was then shown the display of toys which were used as incentives for the younger children, and then given the instructions.

This display of toys and their motivating effect deserve special comment. In any task that involves a large number of trials, boredom may develop quickly and may limit the performance unless some technique is used to sustain motivation over the long period of the experiment. Since this study involved *S*s varying greatly in age particular attention had to be given to this problem. It was clear that no single reward has wide enough appeal to be attractive to all *S*s. For this reason tokens were used which could then be traded in for a reward of a *S*'s own choice. This assured that within the limits of the rewards available, each *S* received something of value to him. To make the experiment a positive experience, an attempt was made to reward all of the *S*s with a toy that they themselves had selected. Rather than place a particular value in tokens on each of the toys, the children were asked to select the toy they liked best and the toy they liked second best. Then, regardless of the number of tokens they had won the *S*s were informed that they had won enough for their first choice. In a few cases where the *S*'s performance was well below the mode for his age group, he was given his second choice.

Another methodological problem arose as a consequence of testing all of the boys from one grade. Since the *S*s knew each other, the possibility existed that those who had already been tested would tell of their experience to those who had not. Since ability to communicate increases with age, and since advance knowledge of the experiment could alter performance, an attempt was made to limit discussion of the experiment between *S*s.

Education of Montgomery County School Systems, and Mr. Marlin Brandt, Supervising Principal of East Norriton School, for their cooperation.

First, the students were told that there would be a grand prize awarded to the boy whose performance was best in each grade. It was implied that it was to each child's advantage not to communicate information since this would reduce his chances of winning the grand prize. After the experiment, one boy was randomly selected from each class and given a $2 certificate that could be used at a local toy shop. The second method that was used to lessen communication was to alternate the task and, in the probability learning task, to alternate the more favorably reinforced side. This meant that conversations in the hallways between the last *S* and the next would be largely irrelevant. The third and possibly most potent factor in eliminating communication was simply the request by the *E* that the children not communicate about the results of the experiment.

No systematic evaluation was made of the success of these methods. However, in no case did a person's performance indicate that there had been any effects of contamination by communication. We found, for example, no case in which *S*s used any of the sequential patterns when faced with the probability task, or other such behavior that might have suggested that some such communication might have taken place.

4. *Design*

Experiment I concerns the development of a kind of probability or trial-and-error learning. The outcome of the *S*'s choices in this situation are determined by a probability mechanism that insures that one of the outcomes will occur 75 per cent of the time while the other outcome will occur 25 per cent of the time. The scheduling of these outcomes was different for each *S* within any particular age range. However, the different schedules of outcomes between age ranges were programmed identically. The experiment itself consisted of 150 trials.

The *S* was asked to depress one of the two levers which he thought was the "correct" one on each trial. If he was correct the red light above the lever he pressed went on, and a marble token dropped into the plastic reward box. These marbles accumulated until after the experiment was over, and were then counted. If the *S* was not correct in his guess no light came on. A green light above the two red ones was the signal for the next trial to begin.

*S*s in the probability task were read the following instructions:

> This is a guessing game. The idea of the game is to see if you can guess which of these two switches is the correct one to pull, and to get as many correct guesses as possible. If you guess the correct one. the red light above the switch will light up. If you guess wrong, the light won't go

> on and that means the other switch was the correct one. You will receive a marble for each time you are correct. The marble will fall into this box. When the game is all over, we will count up the marbles and you can trade them in for one of the prizes on the table. Remember, the more marbles you have collected, the more likely it is that you can get the toy you want. The rules of the game are simple: (*a*) You can pull only one switch at a time; either one or the other, but not both at the same time. (*b*) Each time you must wait until the green light is turned on before you pull the switch. The green light is a signal to begin. (*c*) You may take as much time or as little time as you want before you pull the switch. Are there any questions before we begin? Do as well as you can so that you will be able to get the toy that you want.

The *S*s in the ninth grade received money as rewards, and the instructions were appropriately modified for them. The *S*s were rewarded at the rate of one penny for each five marbles collected.

The second task concerns the acquisition of a concept of sequence. In the sequential task the outcomes were preplanned according to a double alternation pattern—right, right, left, left. Here, as in the previous experimental situation, the *S* was asked to choose one of the two switches and was told that if he selected the correct one a red light would come on above the switch indicating that he was correct; while if he was incorrect, no light would come on. This condition differed from the probability task in that rather than the *S* receiving marbles for correct responses and not receiving them for incorrect responses as in the previous situation, the *S* was given 100 marbles at the beginning of the experiment from which he must pay one marble for each incorrect response. This procedure was followed in order to maintain motivation to do as well as possible. To have given a marble for each correct response would have penalized those bright *S*s who reached the criterion quickly and might have thus altered the peformance of subsequent *S*s.

The *S* was given up to 200 trials in which to discover the correct RRLL sequence. The criterion of solution was 16 consecutive correct responses.

At the end of both experiments an inquiry was conducted in which the *E* endeavored to find out what determined the *S*'s responses.

Two sets of instructions were used according to the incentive used.

For the children who received toys as rewards the following instructions were read:

> This is a guessing game. The idea of the game is to find out which of these two switches is the correct one to pull each time. If you guess wrong the light won't go on and this means the other switch was the

> correct one. You will know if you have guessed right or wrong by watching for the red light.
>
> I am going to give you 100 marbles to begin the game with. Every time you guess wrong the light does not go on and you will put a marble in this hole. When the game is over we will count up all the marbles that you have left and you can trade them in for one of the toys on the table. The more marbles you have left, the better chance you have of getting the toy you want. You will be able to get the most marbles by finding the best solution to this game.
>
> The rules of this game are simple: (*a*) you can pull only one switch at a time, (*b*) you must wait until the green light is turned on before you pull the switch. This green light is the signal to begin, and (*c*) you may take as much time or as little time as you want before you pull the switch.

The instructions read to the ninth grade children, for whom money was the incentive, were appropriately modified. The marbles-to-penny reward ratio was 2 to 1.

C. Results

The focus in the evaluation of the results was the developmental performance curves produced by the two learning tasks. In both tasks the criterion of "successful" performance was the number of marbles obtained by the *S* which could then be traded in for a toy. That is, in both tasks the goal is maximizing the coincidence of the *S*'s response and the pre-established program.

1. *The Ontogenesis of Probability Learning*

In Experiment I a 75-25 program was used; one side had reward-potential 75 per cent of the 150 trials. Here, the performance scores were the number of responses given to the 75 per cent reward lever in the last 50 trials. In the treatment of the data from both probability and sequential tasks distribution-free statistics were used since the distribution of performance scores were skewed.

Figure 1 presents the distribution of median per cent response in the last 50 trials of the lever giving 75 per cent reward for the five age groups. The youngest group was the most discrepant from the others, giving a median of 86 per cent response to the most rewarded lever. From the standpoint of achievement they received the highest per cent reward. The other four groups produce medians which are essentially linear. The negligible inverse relationship between age and response to the 75 per cent side produced a correlation of —.13 which was not statistically significant.

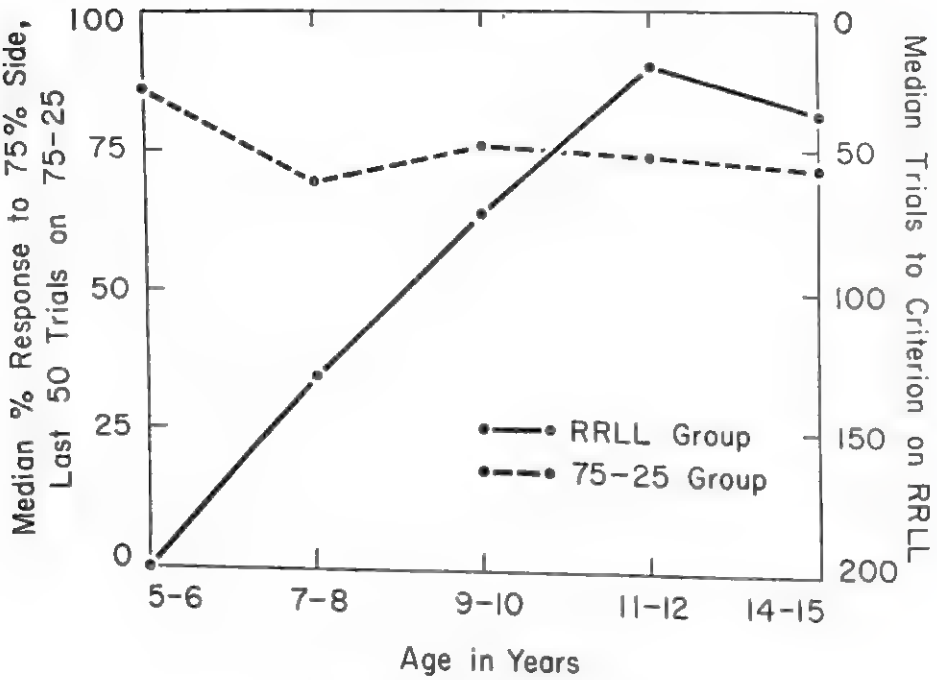

FIGURE 1
RELATIONSHIP BETWEEN PERFORMANCE IN PROBABILITY AND SEQUENTIAL PROGRAMS AND AGE

In a task such as this where the program is a random distribution of lefts or rights in a given ratio, the way to maximize reward is to respond to the more frequently rewarded side in 100 per cent of the trials. In this way the *S* is assured that at least 75 per cent of his trials will be rewarded.

The genetic change in the per cent response given to one side is more striking when the extremes are considered. Here, interest was in the extent to which *S*s become "fixated" to one response lever or the other. "Fixation" was operationally defined as giving 96 per cent or more of the responses in the last 50 trials to one side. Since "correctness" or success of performance is not considered in this measure the fixation score is assigned to *S*'s performance without regard to which side was programmed at 75 per cent. Of the

TABLE 1
CORRELATION BETWEEN AGE AND PERFORMANCE IN PROBABILITY AND SEQUENTIAL PROGRAMS

Program type	Measure	N	rho	*p*
Probability (75–25)	% response to 75% side	122	−.13	> .10
Sequential (RRLL)	no. trials to criterion	118	+.45	< .0005

cases presented in Table 2, only two *S*s gave 100 per cent to the 25 per cent side; the others fixated to the 75 per cent side.

Table 2 presents the distribution of *S*s fixating to one side for age and I.Q. groups. Significantly more younger children fixate than older children. The decrease in number of fixations is quite abrupt between groups of 5–6-

TABLE 2
NUMBER OF *S*s FIXATING (>96%) TO ONE SIDE FOR AGE AND I.Q. ON 75-25 PROGRAM

Age group	Age N	No. fixating	I.Q. group	I.Q. N	No. fixating
5–6	26	13			
7–8	34	5	Superior (>119)	20	1
9–10	17	2	High average (110–119)	28	5
11–12	25	2	Average (90–109)	50	9
14–15	20	1	Dull normal and less <90	13	6
Total		23	Total		21
Chi square = 9.60, 1 df $p < .01$			Chi square = 9.20, 2 df $p < .02$		

year-olds and the 7–8-year-olds. Twelve of the 23 subjects who fixated to one side did so 100 per cent of the trials. Of these 12, 10 were 5- or 6-year-olds and the other two were from the 7–8-year-old group. No child older than 8 years old fixated 100 per cent to either side.

2. *The Ontogenesis of Sequential Learning*

The measure of performance in the sequential learning task was the number of trials required to solve the task to the criterion of 16 consecutive "correct" trials.

It seems clear from Figure 1 that the number of trials required to solve this task decreased as age increased. This relationship between performance and age is monotonic for the four age groups from 5- to 12-year-olds. The correlation between performance and chronological age was +.45 and significant at $p < .005$ (Table 1).

It is noteworthy that of the 118 *S*s in the sequential task, only four fixated to one side, and all four were in the 5–6-year-old group.

3. *The Relationship Between Learning Task and I.Q.*

When the data yielded by the probability task was grouped according to I.Q., the results are consistent with those given by age grouping. The per cent

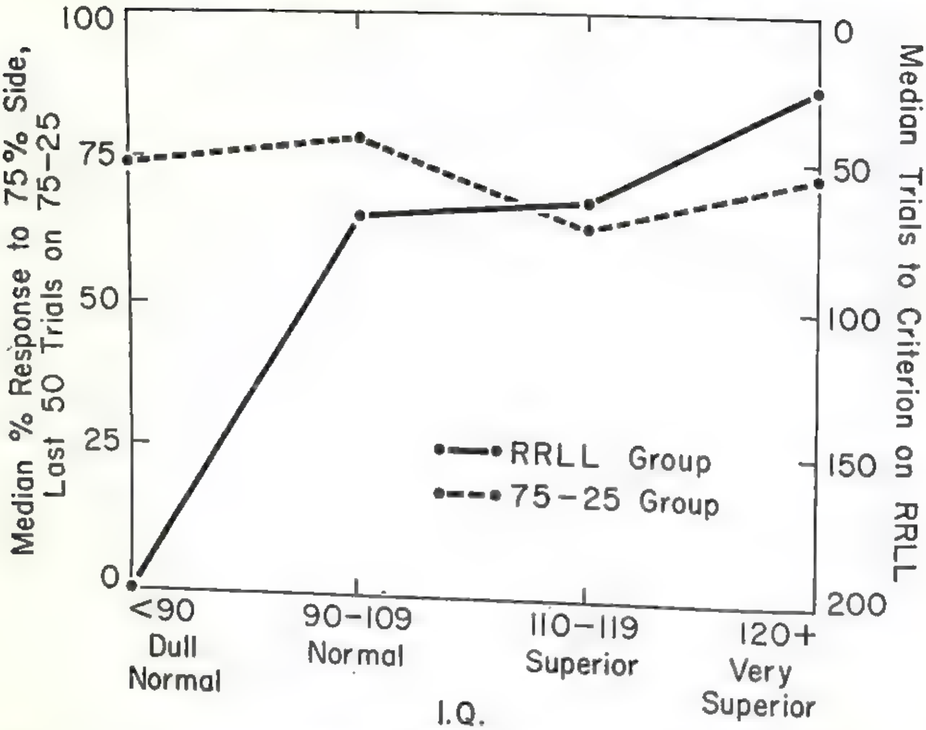

FIGURE 2
RELATIONSHIP BETWEEN PERFORMANCE IN PROBABILITY AND SEQUENTIAL PROGRAMS AND I.Q.

response to the 75 per cent lever was invariant with I.Q. levels (Figure 2), yielding an insignificant correlation of —.10 (Table 3).

I.Q.s, in this analysis, were derived from two tests: the 5–6-year-olds were tested with the Pintner-Cunningham, while with all of the others the Kuhlman-Anderson was used. To assess the relationship between performance in the 75–25 program and I.Q. eliminating whatever variance was contributed by the use of two different tests, rho was calculated excluding the youngest age group. Treated in this manner the correlation was —.16 between response to the 75 per cent level in the last 50 trials and I.Q.

TABLE 3
CORRELATION BETWEEN I.Q. AND PERFORMANCE IN PROBABILITY AND SEQUENTIAL PROGRAMS

Program type	Measure	N	rho	p
Probability (75–25)	% response to 75% side	111*	—.10	$> .10$
Sequential (RRLL)	No. trials to criterion	118	+.44	$< .0005$

* N is less here than for the age analysis since the I.Q.s of 11 children were not available.

Distributing the number of *S*s fixating to one side according to I.Q. level produces a significant chi square (Table 2). Fewer of the brighter children fixate than those at the lower I.Q. levels.

The relationship between performance in the sequential task and I.Q. level is similar to that produced by age levels. Performance is better as I.Q. is increased. The greatest performance discrepancy appears to distinguish the *S*s who achieve I.Q.s of less than 90 from the other groups. The difference in median performance between the superior and normal groups was considerably less than that of the other groups. The correlation between performance and I.Q. was +.44 and is significant at $p < .0005$. When the 5–6-year-olds are dropped from the analysis, to eliminate whatever variance may be attributable to the use of two different intelligence tests, a rho of +.31 is produced which is significant at $p < .005$.

D. Discussion

It appears then, that probability and sequential learning follow different growth curves. Performance in a probability task is invariant with age and I.Q. levels, while performance in a sequential task improves with age and I.Q. Insofar as young children and *S*s lower in I.Q. level do as well, and frequently better, than older and brighter children in the probability task, and since young children perform better in the probability task than on the sequential task, probability learning seems more primitive, that is, a genetically prior mode of learning.

The inquiry which followed the completion of the task suggested that age and intelligence level appeared to play a major role in the way in which the *S* approached the task. The younger children adopted what has been termed a "gambling" orientation (1). The greater frequency with which they fixated on the more frequent event suggests greater inclination to maximize the marble-reward without concern for the number of incorrect solutions. The aperiodicity of the reinforcement was enough to cement their response.

Response to the inquiry revealed that finding a "solution" was relatively unimportant as compared to the goal of receiving enough marbles to trade in for the toy of their choice. This "gambling orientation" is a passive one in that inquiry failed to expose any active intellection devoted to understanding the principle according to which lights could be predicted. Only one child, the brightest, verbalized a solution in terms of maximizing reward by adopting a 100 per cent prediction of the more frequent event. For this one

boy, fixation appeared to be an active manipulation of the task. For the others, fixation appeared to reflect a passive role with regard to the stimuli.

Older children actively sought for some understanding of the principle that determined the order in which the lights flashed on. They sought to impose some order on the capriciousness of the probability program and expressed concern as various hypotheses were attempted and discarded.

The sequential task, in contrast to the probability task, permitted a more active role for the learner. Here, there was a "solution" that could be discovered. For the older children the sequence provided the order they sought and facilitated the adoption of a problem-solving orientation. The inquiry suggested that the older children appeared willing to risk losing a marble on any one trial in order to find the ultimate solution that would give them 100 per cent reward. Failures or successes on individual trials were considered secondary to the ultimate goal of discovering the appropriate sequence. Of course, if the consequences of performance were more crucial to their general welfare or if the rewards were greater than toys and pennies, the willingness of the older children to risk losses may very well have been altered.

In this task the younger children were clearly at a disadvantage in that the gambling approach was not as effective as it was in the probability task. Here, fixation netted them only 50 per cent reward. There were some 5–6-year-olds who readily accepted this reward ratio.

The difference in the two learning tasks as a function of age and I.Q. suggests an interpretation consistent with the notion of maximization of expected utility (1, 2, 3). For younger children the goal was the marble rewards. From the inquiry it appears that the older children placed less absolute value on each trial but were more inclined to view the separate trials as opportunities to verify or negate a hunch about the order. Where there was no easily apprehended order this approach led them astray.

Another factor contributing to the differential effects of age and I.Q. is the intrinsic interest of the tasks and the ability to maintain a repetitive performance. Young children and those lower in intelligence are less easily bored by repetition and thus could accept fixation solution more easily. Older, brighter children soon became bored with the fixated solution and entertained the possibility of predicting the less frequent event. They seem ready to sacrifice initial performance in the pursuit of the best solution.

In an effort to throw further light on the cognitive processes involved in the two learning tasks, performances in the two situations were related to scores of the 5- and 6-year-olds on a reading readiness test. The test used[6]

[6] Hildreth, Gertrude & Griffiths, Nellie. Metropolitan Readiness Tests. New York: World Book Company, 1933.

assesses ability to understand concepts of size and number, recognition of visual patterns, recognition of regularity and order, and differences between visual patterns.

Performance in the sequential task was found to be significantly related to scores in the readiness test (Rho $= +.64$, $p < .0005$, $N = 14$), while performance in the probability task was not related to readiness scores at a significant level (Rho $= -.15$, $p > .10$, $N = 15$). Scores in the readiness test served to distinguish those who fixated to one side in the probability task particularly well.

Six of the seven children who gave 100 per cent response to one lever scored below 71 on the readiness test, while seven of the eight who did not fixate scored 71 or higher ($p < .01$ by the Fisher-Yates Test, 4).

It seems then that the ability to apprehend visual patterns in terms of their shape, number, and regularity is related to performance in the sequential task. Insofar as higher performance in the probability task does not demand even the minimal level of perceptual maturity evaluated in the readiness test, it gives further testimony to the developmental priority of this mode of learning.

These results are consistent with a comparative developmental theoretical orientation, according to which human learning is viewed in terms of different organizational stages.

What is suggested here is that there are different kinds of learning which are appropriate for organisms at different levels of development. These learning modes, by virtue of their appearance and utilization at various ages and intellectual levels, can be classified in terms of greater or lesser primitivity.

This experiment has considered only two kinds of learning tasks, probability and sequential. The results of developmentally-oriented conditioning experiments (5, 6, 7, 8, 9, 10) suggest that conditioned responses can be established very early in life and indeed young children frequently condition more rapidly than adults. Thus, three modes of learning are suggested which, in the order from most primitive to most advanced, are: learning by classical conditioning, probability learning, and sequential learning. The first level appears to be characteristic of the learning approach of infants and very young children and of infra-human organisms. With development—phylogenetic and ontogenetic—the other modes of learning come to the fore and earlier modes recede to the background but remain available when the task situation calls for no more profound level of intellection. This is the theoretical context within which this experiment was conceived.

E. Summary

This study was concerned with the ontogenesis of choice behavior. Boys, ages 5 to 15, were exposed to either probability or sequential learning tasks presented by means of a specially devised binary choice apparatus.

The data produced the following results:

1. The number of trials required to solve the sequential task (RRLL) decreased significantly as age increased.

2. In the probability task the number of responses to the lever programmed to yield 75 per cent reward was invariant with age.

3. Relationships similar to those found between performance and chronological age were also found between performance and I.Q.

The results were interpreted as consistent with a comparative developmental point of view.

References

1. Bruner, J. S., Goodnow, J. J., & Austin, G. A. A Study of Thinking. New York: Wiley, 1956.
2. Davidson, D., & Siegel, S. Decision-Making: An Experimental Approach. Stanford, Calif. Stanford Univ. Press, 1957.
3. Edwards, W. The theory of decision-making. *Psychol. Bull.*, 1954, **51**, 380-417.
4. Finney, D. J. The Fisher-Yates test of significance in 2 × 2 contingency tables. *Biometrica*, 1948, **35**, Parts I & II.
5. Jones, H. E. Conditioned psychogalvanic responses in infants. *Psychol. Bull.*, 1928, 183-184.
6. ———. The retention of conditioned emotional responses in infancy. *J. Genet. Psychol.*, 1930, **37**, 485-498.
7. ———. The galvanic skin reflex in infancy. *J. Child Develop.*, 1930, **1**, 106-110.
8. Kasatkin, N. L., & Levikova, A. M. On the development of early conditioned reflexes and differentiation of auditory stimuli in infants. *J. Exp. Psychol.*, 1935, **18**, 1-19.
9. Mateer, F. Child Behavior. Boston: Badger, 1918.
10. Razran, G. Conditioned responses in children. *Arch. Psychol.*, 1933, 1948.
11. ———. Conditioned response: An experimental study and a theoretical analysis. *Arch. Psychol.*, 1935, **19**.
12. Werner, H. Comparative Psychology of Mental Development. New York: Harper, 1940.
13. ———. Genetic experimental psychology. *Encyclopedia of Psychology.* (P. L. Harriman, Ed.), Philosophical Library, 1946.

National Analysts, Inc.
1015 Chestnut Street
Philadelphia, Pennsylvania

The Journal of Genetic Psychology, 1963, **102**, 19-25.

STUDIES IN OPERANT CONDITIONING: I. ACQUISITION OF A PANEL PRESSING RESPONSE*

Department of Psychology, University of Denver

ALFRED B. SHAKLEE [1]

A. INTRODUCTION

If comparative studies of learning are to contribute to the understanding of phylogenetic trends, it is necessary that some learning tasks be designed to capitalize on distinctive species adaptations. One ideal in this respect is to devise techniques for studying learning and other dimensions of adaptive response in natural or near-natural habitats with observational controls and suitable quantification. Outstanding examples of the possibilities here are seen in such work as that of Heinroth and Lorenz on imprinting in geese, von Frisch's studies of bees, and Schneirla's investigations of maze learning in ants.

At a different level of study there are the possibilities for designing laboratory apparatus to parallel, not only the animal's sensory-motor capacities, but also particular types of adjustment which have over the course of evolution especially fitted the organism to a particular ecological niche. Following Elton (2), the term "niche" is used to specify a broad set of conditions, such as the "mode of life" of the organism. A problem in comparative learning studies is to incorporate as much as possible of the organism's ecological niche into laboratory learning apparatus. Such an emphasis may greatly decrease the time necessary to obtain learning, and yield data which represent more adequately the limits of learning efficiency which an organism can approach.

The writer has combined a number of ideas already in the literature in developing a simple apparatus which, for the rat, gives rapid learning and relatively stable measures of acquisition and extinction. The apparatus is quite similar to that originally devised by Skinner (6) to measure eating behavior of the rat, and out of which developed the lever-box allowing of highly efficient and varied quantification.

* Received in the Editorial Office on December 19, 1960.

[1] This research was supported by a grant (M1527) from the National Institute of Mental Health, and by a University of Denver Faculty Research Grant.

B. Methods

1. *Apparatus*

In order to have the test apparatus similar to the animals' laboratory environment, a standard metal cage (Wahmann, LC-75/C), 25 × 10 × 7 inches high was employed. The cage front, bottom, and removable top were of 1/2-inch mesh hardware cloth. Seven inches from one end, there was placed in the cage a partition to support a vertically sliding door eight inches wide, and behind this, a stimulus panel frame. This left a compartment 18 inches long for the animal. Except as noted below, the partition and all associated surfaces exposed to the animal were painted gray.

The stimulus panel frame supported hinged panels or doors, 1-3/4 × 2-1/4 inches high, located 1-1/2 inches apart and 1-1/2 inches above the floor of the cage. Since it was desired to be able to use the apparatus for discrimination learning, as well as operant conditioning, there were three panels. These had front surfaces of plexiglas, under which could be inserted stimulus papers of different brightnesses. When a panel was unlocked, the free vertical edge could be pushed back a distance of one inch, exposing below, a triangular depression 1/8 inch deep and 1-3/4 inches on the front edge, in which food could be placed.

For all the trials reported herein, black paper strips were present under the plexiglas covers of each panel, and the two outside panels were always locked. Lighting was from two 7-1/2-watt bulbs in reflectors above the ends of *S*'s compartment. In order to encourage more free exploration by *S*, the cage lighting was further reduced by placing layers of white broadcloth over the reflectors. The resulting illumination at the floor, two inches in front of the center of the door, and two inches from the center of the far end of the cage was, in each case, 0.7 foot-candle. Between the cage and the observer there was a black cloth containing an observation slit placed to give a good view of the center door. The observation window, approximately 1 × 3 inches, was covered on the *E*'s side by a piece of transparent cellulose acetate, and on *S*'s side by a piece of white bobbinet. Individual pieces of an oat breakfast food, "Cheerios," were used as the goal food.

2. *General Procedure*

Experimental *S*s were tamed by handling for about one minute apiece on each of four days during the two weeks prior to test. Beginning three days prior to test, *S*s were allowed to feed two hours per day in the evening. On the pre-test day *S*s were placed in the apparatus, with the sliding door

closed, in groups of three to six. This was done twice during the day, first for 15 minutes, and after an interval of six hours or more, for an additional 10 minutes. In order to obtain negative adaptation to the sound of the sliding door, the latter was five times rapidly raised and lowered a distance of about one inch (but not enough to expose the stimulus panels) twice during each of the cage adaptation sessions. After each of these adaptation periods *S*s were placed in individual cages until they had eaten two pieces of goal food, and were then returned to community cages. On the day following, at least three hours before test, *S*s were placed in the apparatus individually for five minutes each.

On the test day, hungry *S*s were placed in the apparatus and allowed to explore for one minute. Then the sliding door was opened to start the first trial. In the course of exploring, almost all *S*s would in time push open the panel covering the food reward—often after apparently having smelled the food through sniffing at the bottom crack of the door. Response latencies were recorded from the time of opening of the sliding door to the time of removal of the goal food. As soon as the animal had taken the food, the sliding door was lowered. Intertrial intervals during learning and extinction were one minute. When, after learning, *S*s were replaced in the apparatus for extinction or spontaneous recovery trials, the initial interval prior to the first trial was also one minute. Training was not continued with animals having latencies over 10 minutes on Trial 1.

On extinction trials no food was present and a stop allowed the panel to move only 1/8 inch. Latency was measured from the time the sliding door was raised until the animal had pushed the panel the 1/8-inch distance to the stop, at which moment the slidng door was again lowered. Extinction trials were run to a maximum latency of one minute unless otherwise noted.

3. *Spontaneous Recovery*

After preliminary research, the following procedure was found to yield reliable measures of spontaneous recovery. Animals were given only a moderate amount of training—to a criterion of three out of four trials with latencies less than 20 seconds. This was immediately followed by extinction to a criterion of one trial with no response in 90 seconds. Animals were then placed in individual cages for two hours, after which they were placed in the apparatus for one minute prior to retest. Eight females, 42–43 days old, and 15–19 hours hungry, were tested under these conditions. In order to keep motivation relatively constant and to avoid a spurious measure of spontaneous recovery from increased hunger at the end of the two-hour

interval, *S*s were fed immediately after extinction a number of pieces of goal food, so that these and the ones received as reinforcement would total 15.

4. *Partial Reinforcement*

In order to study the effects of partial reinforcement, a series of pilot observations were made. Following this, 10 *S*s, six males and four females, 48 days old, were arranged in five like-sex littermate pairs. Members of a pair were assigned at random to receive continuous or partial reinforcement, and tests under the two conditions performed in alternation. In the continuous reinforcement group, there were four reinforced trials, followed immediately by extinction, on the standard schedule. The partial reinforcement group also had four reinforced trials, but spaced over a total of eight runs, in the order + + — — + — — +. Extinction was as in the previous group. Pieces of goal food of uniform size had been pre-selected in order to hold constant amount of reinforcement.

C. Results and Discussion

Typical negatively accelerated learning and extinction curves were obtained. Under the procedures used, *S*s seemed to be close to the asymptote for acquisition in the vicinity of Trial 5. The comparable asymptote for the elevated straightaway of Graham and Gagné (3) was reported to be practically attained by about trial 10.

The nature of the acquisition curve can be gauged from the following median latencies (in seconds) over 12 trials for 11 male *S*s, 96 to 118 days old, and 22–26 hours hungry, at time of learning: 126, 28, 20, 10, 7, 13, 5, 7, 10, 6, 4, 4.

Animals tended to develop somewhat stereotyped and distinctive manners of pressing the panel, and also tended to eat regularly in one location—some immediately in front of the panel, others in the back of the cage. Very characteristic behaviors of ambivalence were noted during extinction. After a few extinction trials, there was often seen within a single trial a series of tentative approaches and withdrawals before a definitive response was made. Many an animal late in an extinction series would sit in the back of the cage, facing away from the panel, with its nose in one of the far corners.

The results for spontaneous recovery are indicated in Table 1. The significance of the recovery effect as indicated by the sign test had a p value of .008. All animals showed some latency decrease below the extinction trial value.

TABLE 1
SPONTANEOUS RECOVERY AFTER EXTINCTION
(N = 8)

	Trials for acquisition	Trials to extinction	Spontaneous recovery latency (seconds)*
Mean	5.6	7.8	29.9
SD	1.5	2.5	28.9
Range	4–8	5–12	7–77

* Significance of recovery to value below extinction criterion: sign test $p = .008$.

Per cent recovery was computed on the basis of the difference between each *S*'s median latency for the three most rapid of the last four acquisition trials and the extinction criterion of 90 seconds. Recovery ranged from 16 to 99 per cent, with a median of 88. A recovery index of this variety can rise above 100 per cent, and would probably do so occasionally in more extensive trials. To the extent that the present response has properties in common with lever pressing, one would expect from the results of Ellson (1) that spontaneous recovery was about complete at the time of test, two hours after extinction.

Partial reinforcement has generally been found superior to continuous reinforcement, insofar as operant training situations are concerned. Skinner (7) reported results showing that different kinds of partial reinforcement schedules can produce bar pressing habits of much greater resistance to extinction than habits based on reinforcement for every response. The critical review by Jenkins and Stanley (5) substantiates the rather generally found advantages for irregular reinforcement in learning. Most research on this topic, however, has employed schedules which lead to a relatively large number of reinforcements prior to extinction. It therefore seemed desirable in the present case to obtain further information in a situation where very few reinforcements would have taken place prior to test.

The outcome of the partial reinforcement experiment is seen in Table 2. The mean number of trials to extinction was 14.8 for the 50 per cent reward group and 6.6 for the group receiving reward on 100 per cent of training trials. Here, then, we have a confirmation of the benefits of partial reinforcement within a situation allowing of only very slight opportunity for the animals to acquire cue mechanisms associated with the two patterns of reward. The present situation should, in the future, lend itself to further analysis of the behavioral supports responsible for the advantages of partial reinforcement.

TABLE 2
EFFECTS OF PARTIAL REINFORCEMENT IN TERMS OF TRIALS TO EXTINCTION

	Type of reinforcement	
	Continuous	Partial*
N	5	5
Mean	6.6	14.8
SD	1.9	5.8
Range	5–10	9–24

* Partial reinforcement superior to continuous, with pair-difference $t = 3.11$; $p < .05$.

In the present apparatus, which employs a response much like one previously used by Grice (4), the allowing of odor cues when the animal is near the food, the making possible of a "rooting" type of response to operate the panel, and the low light intensity are features calculated to allow the rat to display rapid learning. That such construction had a measure of success is reflected by the relatively small amount of pre-training required. Not too infrequently, however, an animal would, on one or more trials, perform at a latency very much out of keeping with previous scores—a generally acknowledged disadvantage of latency measures. Additional taming could be expected to reduce somewhat the variability observed.

With slight modifications, apparatus of this type should prove useful in the study of learning in other species.

D. Summary

An operant conditioning apparatus was developed to stimulate rapid learning in the rat. Reliable acquisition, extinction, and spontaneous recovery were obtained after relatively little pre-training. There was evidence that the acquisition latencies approached asymptotic performance more rapidly than do latencies in the operant conditioning of an open straightaway running response.

In order to compare the effects of partial and continuous reinforcement after a minimum of training, appropriate groups of animals were put through extinction training following four reinforced trials. Although such a procedure can allow of only slight opportunity for the development of differential response cues in the two groups, the partially reinforced group demonstrated significantly superior retention.

References

1. Ellson, D. G. Quantitative studies of the interaction of simple habits: I. Recovery from specific and generalized effects of extinction. *J. Exp. Psychol.*, 1938, **23**, 339-358.

2. Elton, C. The Ecology of Animals. London: Methuen, 1950.
3. Graham, C. H., & Gagné, R. M. The acquisition, extinction, and spontaneous recovery of a conditioned operant response. *J. Exp. Psychol.*, 1940, **26**, 251-280.
4. Grice, G. R. The acquisition of a visual discrimination habit following response to a single stimulus. *J. Exp. Psychol.*, 1948, **38**, 633-642.
5. Jenkins, W. O., & Stanley, J. C., Jr. Partial reinforcement: a review and critique. *Psychol. Bull.*, 1950, **47**, 193-234.
6. Skinner, B. F. Drive and reflex strength. *J. Gen. Psychol.*, 1932, **6**, 22-37.
7. ———. The Behavior of Organisms. New York: Appleton Century, 1938.

Department of Psychology
University of Denver
Denver 10, Colorado

The Journal of Genetic Psychology, 1963, **102**, 27-31.

STUDIES IN OPERANT CONDITIONING: II. RESPONSE INCREMENT DURING EXTINCTION*

Department of Psychology, University of Denver

ALFRED B. SHAKLEE[1]

A. INTRODUCTION

The typical extinction curve in classical conditioning is one showing general negative acceleration of response strength decrease. In a few instances, however, there is an initial rise prior to reduced responding, as shown by Switzer (11), Scott (8), and Hilgard and Marquis (4).

Hovland (5), in research specially designed to study this phenomenon, found evidence in support of the hypothesis that following training, during which there may be built up an "inhibition of reinforcement," the changed stimulus conditions of the first extinction trial may act as a disinhibitor of the previous inhibition, thus allowing of greater response on the second or third extinction trial.

A slight, gradual increase in performance later in extinction has been reported by Reynolds (7), and by Grant, Riopelle and Hake (1). The latter authors showed by a trend test that the upward slope of extinction curves for a conditioned blink response was highly significant, but underlying mechanisms are uncertain.

It is of some importance to know to what extent similar phenomena may be found in operant conditioning. When such effects are noted, the question then arises as to how similar the underlying processes may be to those presumed to hold in the classical situation. The present study examines the problem of response increment within extinction of an operant response.

B. METHOD

A panel-pressing habit described previously (9) was developed in 24 experimentally naive male hooded rats, 102 to 115 days old, in a study of memory disruption, some phases of which will be reported later. Training and extinction trials were at intervals of one minute, and latency of response was recorded as the interval between the uncovering of the stimulus panel by

* Received in the Editorial Office on December 19, 1960.

[1] This study was supported by a research grant (M1527) from the National Institute of Mental Health and by a grant from Mrs. Margaret E. Davis to the University of Denver.

raising a sliding door, and subject's taking of the reward food behind the panel. For the 18 subjects in the main study, the testing procedure involved eight acquisition trials, followed by an interval of six hours in the home cage without additional food, and after this 12 extinction trials. A second group of six animals was later tested under conditions of eight acquisition, and 10 extinction trials, with an interval of only one minute between acquisition and extinction. Animals were 20–28 hours hungry at the start of training.

C. Results

Median latencies over six trials for the one-minute and six-hour groups are given in Table 1. All but two of the 18 subjects in the six-hour group showed decreased latencies on Trial 2. A pair-difference test yielded a t value of 3.87, significant at the .002 level.

TABLE 1
Median Response Latencies (Seconds) During Extinction

Trial	Time prior to extinction	
	1 min.	6 hrs.*
1	2.8	12.5
2	5.5	8.0
3	4.0	6.5
4	5.0	7.5
5	7.0	6.5
6	12.5	7.0

*Latency decrease between Trials 1 and 2 significant at .002 level.

The subjects having only one minute between acquisition and extinction had a longer median latency on the second extinction trial than on the first, with four of the six animals showing increases. The subjects in the one-minute group were selected for study after six-hour results had been obtained, and hence do not constitute a random replication. For the above reason, and because differential hunger could have influenced the relative performances of the two groups, statistical inter-group comparisons are not presented.

D. Discussion

It is perhaps not reasonable to expect that the theoretical formulation to explain extinction response increment in classical conditioning, as tested by Hovland, could adequately describe analogous data in operant conditioning. It is interesting to note, however, that from a disinhibition hypothesis one might predict for operant conditioning, as well as for classical, that only groups having short intervals between the end of acquisition and the

start of extinction should demonstrate early extinction increment—a prediction which is contradicted by the present results.

If we construct a similar explanatory principle in terms of stimulus satiation, a similar prediction seems in order. As the data of Heathers (2) and others suggest, repeated exposure to a stimulus involves greater aversive tendency soon after stimulation than later.

In discussing an observed drop in bar pressing latency between extinction Trials 1 and 2, Hickey (3) proposed that the behavior was suggestive of a warm-up effect. If warm-up or set to perform is the major determiner of the phenomenon under study, the prediction would be that long-interval groups should show more early extinction response increment than would short-interval groups. It is to be expected in any repetitive practice involving closely spaced trials that residual stimulation patterns left by performance of the response, and present during subsequent responding, will gain a degree of associative strength for response evocation. The absence of such stimulus cues, resulting from the response not having been recently performed, could lead to decreased response strength, even though the adequate exteroceptive stimuli were present. If such a mechanism were the major factor, one would expect no rise in the extinction curve when extinction trials were spaced as a direct continuation of acquisition.

Direct observation of the animals in the present research suggested that dimensions of frustration played a part in the effect. Lowering the sliding door on the first extinction trials generally evoked intensive pushing and biting of the apparatus. Skinner (10) discussed possible effects of emotion produced by extinction trials in a lever pressing operant, and offered an analysis of extinction curve fluctuations based on the assumption that the emotion depressed responding. In the present situation, it is proposed that emotional factors have the opposite effect, i.e., they enhance response, at least on the trial following the first omission of reinforcement. Emotion may, in the present type of measure, contribute to behavioral variability later in extinction through depressive effects. Observations have not been obtained relative to this possibility.

A number of writers have examined operant extinction phenomena in the light of a frustration-drive hypothesis, postulating that frustration can generate motivation which retards extinction. Lambert and Solomon (6) found that rats extinguished close to the goal box demonstrated both more excitement and greater resistance to extinction. The first extinction trial should for many purposes be looked upon as the last learning trial, since the subject's behavior is predicated solely on previous reinforcement, at least

under a 100 per cent reinforcement schedule. The first impact that frustration-drive could have would then be on the second extinction trial, the one where increased responding was noted for the six-hour animals in the present study.

It appears reasonable to predict from the frustration drive hypothesis that, within wide limits, there will be a direct relation between the strength of relevant drive operating in the organism and the amount of early response increment in operant extinction.

Warm-up and frustration-drive, while considered to be far from unitary or "univocal" variables in their influences on extinction, seem to be more closely related to the present outcome than is disinhibition. Clear evidence, however, on the mechanism of operant extinction response increment is not yet available.

E. Summary

The extinction of a panel-pressing response was studied in hooded rats, and a significant response increment on the second extinction trial was demonstrated. Possible explanations for this phenomenon were examined, and deductions of alternate theories analyzed. Observations of the behavior of the animals and other factors were interpreted as suggesting that warm-up and frustration-drive are related to the type of effect recorded.

References

1. Grant, D. A., Riopelle, A. J., & Hake, H. W. Resistance to extinction and the pattern of reinforcement. I. Alternation of reinforcement and the conditioned eyelid response. *J. Exp. Psychol.*, 1950, **40**, 53-60.
2. Heathers, G. L. The avoidance of repetition of a maze reaction in the rat as a function of the time interval between trials. *J. of Psychol.*, 1940, **10**, 359-380.
3. Hickey, A. E. Spontaneous recovery of R_1 following interpolated acquisition and extinction of R_2. *J. Exp. Psychol.*, 1956, **51**, 155-160.
4. Hilgard, E. R., & Marquis, D. B. Acquisition, extinction, and retention of conditioned lid responses to light in dogs. *J. Comp. Psychol.*, 1935, **19**, 29-58.
5. Hovland, C. I. "Inhibition of reinforcement" and phenomena of experimental extinction. *Proc. Nat. Acad. Sci.*, 1936, **22**, 430-433.
6. Lambert, W. W., & Solomon, R. L. Extinction of a running response as a function of distance of block point from the goal. *J. Comp. & Physiol. Psychol.*, 1952, **45**, 269-279.
7. Reynolds, B. Extinction of trace conditioned responses as a function of the spacing of trials during acquisition and extinction series. *J. Exp. Psychol.*, 1945, **35**, 81-95.
8. Scott, H. D. Hypnosis and the conditioned reflex. *J. Gen. Psychol.*, 1930, **4**, 113-130.
9. Shaklee, A. B. Studies in operant conditioning. I. Acquisition of a panel pressing response. *J. Genet. Psychol.*, 1963, **102**, 19-25.

10. Skinner, B. F. The Behavior of Organisms. New York: Appleton Century, 1938.

11. Switzer, St. C. C. Backward conditioning of the lid reflex. *J. Exp. Psychol.*, 1930, **13**, 76-97.

Department of Psychology
University of Denver
Denver 10, Colorado

The Journal of Genetic Psychology, 1963, **102**, 33-36.

STUDIES IN OPERANT CONDITIONING: III. LEARNING IN THE RAT WITHOUT PRIOR EXPERIMENTAL ADAPTATION*

Department of Psychology, University of Denver

ALFRED B. SHAKLEE[1]

A. PERCEPTUAL EXPERIENCE IN THE CONTROL OF LEARNING

A great stimulus to learning research has been Hebb's emphasis (3) on the importance of early perceptual experience for later efficiency in learning and problem solving. Many variables, such as age, taming, and environmental variation or restriction, can be included among those which influence an organism's perceptual history. There is presumably interwoven in the effects of most perceptual experiences, a pattern of interacting emotional and cognitive dimensions.

Studies of age in relation to learning in the rat have perforce involved combinations of the variables of maturation and experience. It seems clear, however, that very young rats are inferior in learning ability. Liu (5) found that maze learning efficiency in rats increased with age for groups beginning learning at ages between 30 and 75 days. Even younger rats were studied by Biel (2), who began taming the animals and giving them swimming experience as early as the age of 16 days. Subsequently, the animals were trained over a period of six days in a water maze, the youngest at ages 17–23 days, and the oldest at 30–36 days. Again there was a direct relationship between age and learning performance.

The benefits and frequent necessity of taming in order to obtain efficient learning in animals are widely recognized, although the importance of such treatment varies with species and tasks. Karn and Porter (4) have quantified such effects and shown that rats which received habituation to handling and certain maze-related experiences possessed an advantage in later maze learning. Similarly, Bernstein (1) noted that rats handled for 10 minutes per day from days 21–60, were superior to controls in T-maze learning begun at the age of 60 days.

* Received in the Editorial Office on December 19, 1960.

[1] This study was supported by a research grant (M1527) from the National Institute of Mental Health, by a University of Denver Faculty Research Grant, and by a grant from Mrs. Margaret E. Davis to the University of Denver.

The rat is very susceptible to emotional interference in learning performance. One would expect, however, that in apparatus duplicating the animal's living conditions and capitalizing on natural adaptive tendencies the need for special experimental adaptation could be reduced. Since Yerkes did not have to tame the worms with which he worked, and Schneirla did not tame his ants prior to maze learning, it seemed reasonable to expect that some learning might be extracted from rats, without special experimental adaptation.

The present research was designed to determine whether rats could master, at an early age, a simple habit in a single test session, without prior systematic taming. It could be expected on the basis of Hebb's theoretical formulation and experimental data on the age factor, that any learning obtained would be inferior to that of tame adult animals.

B. Method

Hooded rats were trained to perform an operant panel-pressing response two days after weaning. Learning was accomplished by eight subjects, four females and four males, in a single session when they were 25 days old. The apparatus has been described in an earlier report (6).

The only handling received by the animals was their being picked up for anesthetization and ear marking and return to a large cage, on the day of weaning. The post-weaning living cage was identical with the one in which the learning apparatus was later placed. Except as noted above, the animals had no human contact until they were picked up and placed in the test cage for learning trials. Once on each of the two pre-test days, pieces of goal food were placed in the living cage when no other food was present, and were quickly consumed. Pieces of food were counted to allow an average of five per animal.

One minute after an animal was placed in the test apparatus, a sliding door was raised to expose the stimulus panels and begin the practice trials. Response latency was recorded as the interval between the exposing of the stimulus panel and the subject's taking of the goal food behind the panel.

The three stimulus panels, only the middle one of which could be moved by the animal, were marked somewhat differently than in the earlier study. The outer panels had gray paper visible under their plexiglass covers, while the center panel had black paper. If these cues have any effect over early trials, it should be to make the problem easier than when all panels are black.

Pieces of the breakfast food, "Cheerios," were again used as the goal food. In order not to satiate the animals, which were 12–17 hours hungry at time of test, small Cheerios, weighing approximately 0.1 gm., were placed indi-

vidually in the goal. These were large enough in diameter not to fall through the three mesh hardware cloth floor of the testing cage. Five trials were given, with intertrial intervals of one minute. It had been found in pilot work that a proportion of animals of this age seemed to show decreased motivation shortly after five trials. Four subjects not responding within seven minutes on Trial 1 were discarded.

C. Results and Discussion

To the writer's knowledge, quantitative information has not previously been available on mammalian learning of this type under conditions combining such young age and lack of taming. Table 1 shows the performance of the

TABLE 1
MEDIAN LATENCIES (SECONDS) FOR ACQUISITION TRIALS

Trial	Age-experience group: Young non-tame	Age-experience group: Mature tame
1	256	168
2	43	23
3	27	20
4	33	10
5	24	10

experimental animals, and contrasts it with the performance of 14 mature animals tested earlier after undergoing the previously described (6) sequence of handling and habituation to the apparatus. The older animals were of the previous generation of the same stock, averaging approximately 100 days in age.

Since there was unusually high variability in the performance of the young animals, it was decided to compute a *t*-test for gains between the means of the first two and last two trials. The pair-difference *t* value of 4.08, significant at the .005 level, documented the significance of the behavioral change as trials progressed. Even the change between the means of Trials 2-3 and 4-5 yielded a *t* of 2.27, with *p* between .06 and .05. The performance of the young animals was inferior to that of the older ones, though this did not seem related to any inhibition of motor performance—a factor which must be considered in interpreting latencies. The young animals were actually more active than the older ones when in the learning apparatus. Observation of the animals also suggested more confusion on the part of the young ones in correctly selecting the center stimulus panel after previous reinforced trials.

In speaking of taming as a variable in animals learning, one is dealing with a complex type of influence, which logically transcends any specific taming operations introduced by the experimenter. There is no sharp distinction between intentional taming activities and influences associated with caring for animals, the routine and location of the laboratory, and the brute fact that, regardless of what the experimenter adds to experience, the animal is continually in an environment. As learning progresses, considerable habituation can take place—especially so, if learning trials are scheduled over many days.

Not only had the experimental animals been free from a routine of handling, but they also had had no experience with the experimental room or the specific features of the test apparatus until one minute prior to their first learning trial. The freedom with which these animals moved about in the apparatus, and other comparisons between young and old animals in laboratory tests, suggest that for certain situations young animals need less habituation experience in order to reach an asymptote of performance.

D. Summary

It has been found possible to demonstrate learning in a single session in untamed, 25-day-old rats. As would be predicted from knowledge of the roles of maturation and experience, the performance was less efficient than that of mature, tame animals. The present finding seems to offer a promising research tool for learning studies.

References

1. Bernstein, L. A note on Christie's: "Experimental naivete and experiential naivete." *Psychol. Bull.*, 1952, **49**, 38-40.
2. Biel, W. C. Early age differences in the maze performance of the albino rat. *J. Genet. Psychol.*, 1940, **56**, 439-453.
3. Hebb, D. O. The Organization of Behavior. New York: Wiley, 1949.
4. Karn, H. W., & Porter, J. M., Jr. The effects of certain pretraining procedures upon maze performance and their significance for the concept of latent learning. *J. Exp. Psychol.*, 1946, **36**, 461-469.
5. Liu, S. Y. The relation of age to the learning ability of the white rat. *J. Comp. Psychol.*, 1928, **8**, 75-85.
6. Shaklee, A. B. Studies in operant conditioning: I. Acquisition of a panel pressing response. *J. Genet. Psychol.*, 1963, **102**, 19-25.

Department of Psychology
University of Denver
Denver 10, Colorado

The Journal of Genetic Psychology, 1963, **102**, 37-43.

EFFECT OF PROLONGED SHOCK STRESS ON TIMIDITY AND EMOTIONAL ELIMINATION IN THE RAT* [1]

Carnegie Institute of Technology

K. E. MOYER[2]

A. INTRODUCTION AND PROBLEM

The effects of stress on physiological changes have been studied a great deal in recent years but relatively little work has been done on the effects of stress on behavior. Stern (5), using electroconvulsive shock as a stressor, has shown that activity is reduced and that emotionality is increased in an open field situation. He also demonstrated that these behavior changes endure for over 100 days. Further, he has shown (5) that E.C.S. produces a relatively long-lasting increase in timidity.

Griffiths (1) studied the effect of stress on an extinguished fear response in a modified Miller-Mowrer box. His subjects were forced to run on a treadmill with a non-injurious shock as a motivator for a five-minute period daily for one week. He came to the conclusion that this stressor significantly reinstated a previously extinguished fear response. Control subjects showed no spontaneous recovery. Moyer and Bunnell (4) showed that rats subjected to noise stress plus operative stress manifested greater emotionality than controls given noise alone, operative stress alone, or no stress. Emotionality in this experiment was measured by a modification of the Hall (2) open-field test.

Malmo (3) reports several experiments with humans in which it was shown that psychiatric patients showed a higher level of arousal than did non-patients in a standard stress situation. Those patients suffering mainly from pathological anxiety showed the highest level of arousal. Malmo conjectures from these studies and other data that anxiety and consequent high arousal level is brought about by stimulation which keeps physiological levels high over a long period of time. He suggests further that it should be possible to "produce anxiety in animals (*i.e.*, animals with raised physiological levels in standard situations)." Any form of stimulation which

* Received in the Editorial Office on January 3, 1961.

[1] This investigation was supported in part by a research grant M-1298, from the National Institute of Health, Public Health Service.

[2] The author is indebted to Mr. Andrew Chenzoff who tested the animals.

maintains high levels of physiological reaction over long periods of time should produce the anxiety state which it is presumed would influence behavior in situations away from the stressor stimuli.

It is the purpose of this study to investigate the effects of intense, prolonged stress on the manifestation of emotionality in situations outside of and unrelated to the stressful one.

B. Method

1. *Subjects*

In this experiment 31 naive, hooded, female rats from the colony at the Carnegie Institute of Technology were used. All subjects were between 82 and 87 days of age at the beginning of the experiment.

2. *Apparatus*

The grill boxes were 12-1/4 × 10-1/4 × 8-1/2 inches, made of plywood with a plexiglass front. The walls and ceiling were painted with aluminum paint. In the ceiling was a three-inch speaker covered with hardware cloth. A 7-1/2-watt light bulb was also affixed to the ceiling and was on at all times.

The floor was composed of 1/8 inch brass rods spaced 3/4 inch apart. The shock administered through these rods was controlled by an electronic shocker with sufficient resistance built into the circuit to minimize individual resistance differences in the subjects. The intensity of shock used was 3.5 to 4.0 ma. This was sufficient to elicit violent escape responses from the subjects. The three-minute intershock intervals were controlled by a Gerbrand tape type timing mechanism. The 2/10 second shock duration was controlled by a Decade interval timer.

Each grill box was kept in an individual soundproof box and was ventilated by means of a blower which provided a constant low level noise. The room temperature was maintained at between 74° and 76° throughout the lives of the subjects.

The open-field apparatus consisted of a table top covered with white oil cloth. It was 23 × 33 inches with sides of composition board painted gloss white 15 inches high. A 200-watt bulb was placed 23 inches above the table, and the table top was 29 inches above the floor.

The timidity apparatus consisted of a box made of one-inch pine and painted black inside and out. The inside dimensions were 12 inches long, five inches wide, and 7-1/2 inches high. The cover was light tight. A sliding door covered an opening three inches wide by five inches high. A

one-inch strip of wood extended 12 inches into space from the center of the door. A circular glass food dish 1-3/4 inches in diameter was placed on the end of the runway 10 inches from the door opening. The dish was baited with ground lab chow mixed with condensed milk. An unshaded 7-1/2-watt bulb was placed 15 inches above the center of the runway and constituted the only light in the room. The box was screwed to a table top 32-1/2 inches above the floor; the front of the box extending four inches over the edge of the table. The rest of the room was screened from the subject by a gray panel five feet six inches high on two sides and an aluminum screen which was placed between the subject and the experimenter. A clock was placed 12 inches from the subject on the side away from the experimenter.

3. *Procedure*

When the animals were 82 to 87 days of age they were put in single cages and given food and water ad lib for five days. For the next 14 days they were allowed access to food and water for one hour per day. At the end of the deprivation period they were divided into experimental and control groups. The 16 control subjects were treated in the same manner as the 15 experimental subjects except that they were never placed in the grill boxes.

The experimental subjects were placed in the grill boxes 22 hours and 50 minutes per day for five days. During the period in the grill boxes they were subjected to 2/10 second of 3.5 to 4.0 ma. of shock to the feet every three minutes. Although the subjects made violent, and, for periods, persistent escape responses and did occasionally avoid a shock, frequent observation indicated that none of them learned to avoid the shocks by any method that was consistently successful.

At the end of each day's stress period the subject was given a 10-minute trial in the timidity box according to the following procedure. The subject was placed in the starting box with the front door closed and left there for one minute. The door was then opened. Time measures from the time the door was opened were taken on the following behaviors: (*a*) head out; (*b*) both front paws on the runway; (*c*) all four feet on the runway; and (*d*) start eating. The number of times the subject left the box and again returned to it was also recorded. The trial was terminated after the subject had eaten for 25 seconds. The trial was also terminated 10 minutes after the opening of the door if the subject had not reached the food by that time.

Immediately after the timidity trial the subjects were placed in the home cage and given access to food and water for one hour. They were then returned to the grill box.

Thus, the experimental subjects had five periods in the grill box and five timidity trials. After the last timidity trial all subjects were returned to their individual home cages and given food and water ad lib. Forty-eight hours later all subjects were tested for emotional elimination in the open field. Each animal was placed in the center of the open field for a 10-minute period once a day for five days. A record was kept of the number of fecal bolluses produced and the days on which the subject urinated. Between trials the sides were removed and the oil cloth was washed with warm water and allowed to dry. A record was also kept of the number of fecal bolluses produced in the home cage situation.

The control subjects were on the same deprivation schedule, and were given timidity trials just before being fed.

C. Results

Table 1 shows the means for the various subscores and total time of trial in the timidity box. Although all the subscores are in the same direction (*i.e.*, the stressed subjects took longer to emerge from the box), t tests indicated that only the total time of the trial was significant beyond the .01 level of confidence, $t = 3.14$.

Table 2 indicates means for the emotional elimination measures. The t tests show that the differences between the groups are significant at the

TABLE 1
MEAN SCORES ON TIMIDITY BOX TEST IN SECONDS

	Head out	Forepaws on runway	Four feet on runway	Eat	Returns to box	Total time of trial
Control group	185.9	558.9	791.7	995.9	10.75	1421.2
Stress group	364.0	807.2	1119.5	1455.8	14.67	2213.0

TABLE 2
MEAN EMOTIONAL ELIMINATION SCORES AND t TESTS BETWEEN GROUPS

	Total bolli produced in open field	Days defecated	Days urinated	Total daily bolli produced in home cage
Control group	1.9	.31	.56	323.0
Stress group	9.6	1.2	2.0	314.5
t	2.37	2.25	2.37	.66

.05 level of confidence on all measures except the total number of bolluses produced in the home cage situation.

D. Discussion

These data clearly support the hypothesis that a prolonged period of stress increases the emotional reactivity of the rat outside the stress situation itself. The increased emotionality occurred in the timidity apparatus immediately after the stress period. It was also manifested in the open field 48 hours after the subject had been removed from the stressful environment and returned to the secure and familiar home cage.

Although it was not possible to take physiological measures on these subjects during the stress period, it was quite obvious to any observer that these subjects were more aroused than the control subjects who remained in the home cage. This situation of intense stimulation lasted for 22 hours and 50 minutes a day for five days, and was thus prolonged. According to Malmo's formulation, then, we should have a situation in which anxiety is produced in animals and they should be chronically over-reactive (physiologically) to every stimulating situation.

Such an interpretation appears to be clear in the open field in which the measure was urination and defecation which is presumed to be an indirect measure of autonomic activity. The strangeness of the open field evokes a fear response, one component of which is activity of the sympathetic nervous system. If the onset of sympathetic activity is sudden and intense there is a compensatory activity of the sacral parasympathetic with a consequent loss of sphincter tone and resultant defecation and urination. Thus it seems safe to say that stressed subjects were physiologically more reactive to the stimulation of the open field.

It is also clear, however, that the experimental subjects were not just over reactive in general. The count of the number of fecal bolluses produced daily in the home cage indicated that the difference between the two groups was not significant. In fact, the control group produced slightly more bolluses than did the experimental group. We are, therefore, assured that the stress situation did not simply produce rats with diarrhea. As with Malmo's psychiatric patients, the experimental subjects did not differ from controls under resting conditions.

In the timidity situation there is also a significant difference between the two groups. Since no physiological measures were taken, it is not possible to determine whether the subjects were physiologically more reactive at this stage or not. Increased physiological reactivity may, however, be inferred. It is gen-

erally assumed that the more timid rat takes longer to come out of the box and approach the food, because the stimuli confronting it outside the box are strange and tend to elicit fear responses. These include autonomic involvement and avoidance tendencies which are incompatible with the approach tendencies generated by the hunger and exploratory drives. Because of the increased autonomic activity, it might be said that the subject is physiologically more reactive.

Another possible interpretation of the results on the timidity box is that the stress situation simply reduced the general activity level of the subjects. If the rats were generally more sluggish in their behavior, they would be expected to take longer to emerge from the box. Since activity measures were not taken, it is not possible to test this hypothesis.

Regardless of the interpretation it is clear that this particular stressor changes the organism in some way which causes it to behave differently outside the stress situation, and this effect lasts at least 48 hours after the termination of stress. Further research can determine how the organism was changed and what can be done to prevent or counter these changes.

E. Summary

Thirty-one naive, female, hooded rats were used in this study. The experimental subjects were placed in grill boxes and subjected to 3.5 to 4.0 ma. of shock for 2/10 second every three minutes for 22 hours and 50 minutes per day for five days. The control subjects remained in the home cage during this period. All subjects were tested in the timidity apparatus immediately after each stress period and then given one hour of access to food and water. After the last stress day, the subjects were returned to the home cages and given food and water ad lib for 48 hours. They were then tested in the open field 10 minutes a day for five days.

The results indicate that the stressed animals take significantly longer to leave the timidity box and are significantly more emotional in the open field.

References

1. Griffiths, W. J., Jr. Effect of stress on an extinguished fear response. *Science*, 1955, **122**, 1267-1268.
2. Hall, C. S. Emotional behavior in the rat: I. Defecation and urination as measures of individual differences in emotionality. *J. Comp. Physiol.*, 1934, **18**, 385-403.
3. Malmo, R. B. Anxiety and behavioral arousal. *Psychological Review*, 1957, **64**, 276-287.
4. Moyer, K. E., & Bunnell, B. N. Effect of adrenal demedullation, operative stress and noise stress on emotional elimination. *J. Genet. Psychol.*, 1960, **96**, 375-382.

5. STERN, J. A. The permanence of effect of a series of electroconvulsive seizures on open-field behavior. *J. Comp. & Physiol. Psychol.*, 1956, **49**, 411-415.

6. STERN, J. A., MCDONALD, D. G., & WERBOFF, J. Effect of E.C.S. and ether E.C.S. on behavior in the timidity box. *Psychological Reports*, 1956, **2**, 421-430.

Department of Psychology
Carnegie Institute of Technology
Pittsburgh 13, Pennsylvania

The Journal of Genetic Psychology, 1963, **102**, 45-50.

CHILD PSYCHOLOGY: A LOOK AT TOMORROW*[1]

Montclair State College

DANIEL BROWER

The philosopher, Alfred North Whitehead, says:

> Mankind is now in one of its rare moods of shifting its outlook. The mere compulsion of tradition has lost its force.

Our ship of state is in a storm and we are frantically trying to hold down each of its sails. Are we sure—very sure—of the fact that a democratic society breeds conflicts, confusion and inconsistencies in its values and in the way in which its young people internalize these values into their own behavior and thinking patterns? An authoritarian or totalitarian society has less value conflict—values are prescribed without the Jeffersonian value of freedom or choice. Child rearing is simpler in a non-democratic society. But let's not blame our *democracy* for its ever rising delinquency rate—let's blame our methods. Let's not blame the *freedom* which some abuse, trample, usurp, exploit and twist to their own sick ends. Let's blame ourselves as *persons,* still lacking in the courage to adapt our basic values to new and changing problems. A democratic society demands greater emotional maturity from all of us.

Now—if value conflicts breed neurosis and delinquency in our youngsters, and if democracy fosters value conflicts, is it all hopeless? Far from it. Our challenge is just all the greater. Great goals deserve great effort, persistence, tenacity and a flexible imagination.

I feel it is timely to add, while President Eisenhower and Premier Khrushchev sit face to face this very day on a pile of hydrogen bombs which are slowly ticking off, that values are culture-bound. You cannot validly compare educational and therapeutic efforts in the U.S. and the Soviet Union without correcting for the vast differences in the basic values.

Why should we care about values? One patient completed his psychotherapy well-adjusted and happy. There is little question of the value to be assigned: a favorable or good result. Another attempted suicide: this

* Received in the Editorial Office on January 4, 1961.

[1] Presented as main address at Essex County Branch, White House Conference on Children and Youth, September 26, 1959, South Orange. N.J.

is evaluated as a bad result. But what about the one ending in divorce—is this good or bad? And for whom? And by what standards?

I want to discuss with you the matter of value judgments. In education, and all therapy efforts, we make value judgments implicitly if not also explictly, i.e., "the child is doing much better"—well, better by what criteria? We don't spell out our criteria of judgment—herein lies the greatest weakness in our total efforts for the youngster. Most professional disagreements among us reflect jumbled and unverbalized standards of evaluation. Before Watt invented the steam engine and Whitney the cotton-gin, thus ushering in the Industrial Age, the world was generally concerned with *goals* and the evaluation of means used to attain these goals especially in approaching any mental, educational, medical, community, or welfare problem. But then our technical era brought a mechanistic approach to the problem of means towards goals—a mechanistic, quantitively exact, valueless, yes, even *heartless,* approach to methods. It was as if we *could* do away with values! We have been becoming highly efficient machines, teaching, treating, testing, assigning, deciding, etc., in matters regarding our youngsters with less and less orientation towards clearly formulated values.

But all along, during the last 75 stormy years, we have been able to maintain the thread of that which differentiates man from the chimpanzee, i.e., the ability to *evaluate* his efforts towards certain goals in relation to his past experiences *and* in the light of certain principles of self-direction according to a scale of things held in higher or lower esteem—our values. This thread (or maybe history will call it an unbreakable cable!) has been maintained by two vigorous, seemingly opposed, forces:

1. Judeo—Christian Ethics—providing our society with a *code* of moral values over and above human bounds.

2. Freud's penetration into the unconscious *origins* of our values and inconsistencies, or conflict among our values.

These two forces bespeak the emptiness of a purely mechanistic view of human growth.

May I quote from Albert Einstein on the matter of the centrality of human values in even the physical sciences?

> Concern for man himself and his fate, must always form the chief interest of all technical endeavors—never forget this in the midst of your diagrams and equations.

How much more infinitely true this is in delving into the most human of the human sciences: The growing science of child and adolescent devel-

opment. *Now*—in order to deal more clearly with this problem, I'd like to spell out a few thoughts on mental health.

The usual way of looking upon mental health has been in terms of the lack of disease—a negative approach, and a projection of a medical criterion. This is based upon a value of disease-avoidance, disease-prevention or disease-treatment. This does not explain the complexity of mind and total human experience and the total crisis confronting our civilization at all adequately—any more than peace can be defined as the absence of war, for by such negative criteria peace may be loaded with all the germinating forces leading to war. World War II has ended but has a positive peace even begun?

We need a *positive* approach to mental health where the new value is health as *health!* Marie Jahoda has amplified this very thoroughly of late.

A child may be devoid of academic failure, physical impairment, delinquent, neurotic or schizophrenic signs but may nevertheless be unhappy, lacking in mental vim, vigor and vitality. Such a child is not *sick* but he is unhealthy in his *total* mental organization.

A conceptualization of positive mental health might well embrace at least six crucial factors:

1. Attitudes of the individual to himself—his self-image.
2. Degree to which he realizes his innate potentialities and acquired skills through action—not phantasy alone.
3. Degree to which his various functions and roles in life are integrated according to a self-consistent pattern which is harmonious.
4. Degree to which he has resolved dependencies and can function independently of social influences, i.e., is he self-motivated?
5. How much stress tolerance does he have? Here we find anxiety tolerance, depression tolerance, pain or deprivation tolerance, etc.
6. How well balanced and matured are his capacities for loving and being loved?

Let me list, more concretely, for you some of the conflicts in our values which I feel cause strain, disruption or disturbances in our children—

1. Show respect for *your* elders while disparaging aging, or any object more than a few years old.
2. The more you enjoy your work the more successful will you be, but choose a career principally by the dollar standard.
3. Let's get all children tested and then stimulate them to work up to their fullest capacity levels—but we evaluate teachers and methods

largely in terms of student popularity and against the criterion of making the work interesting.

4. We give millions of intelligence and aptitude tests each year, and then counsel our young according to the Horatio Alger myth—(Anyone can do anything if he only tries hard enough).
5. We talk *mental health* in an endless chain of lip service but positive mental health is still the low man on the American totem pole. Do we unconsciously *fear* that such a program would force us all to grow up a little more? Is our collective emotional maturity too defective to permit mental health to rise in our scale of values? Mental health cannot be compromised. It is the crown of any person's total life pattern. Rather than usurp or sweep aside our other values for child development—mental health fosters better study habits, improved physical well-being and socialization. It is the master-key opening all other doors for the child.
6. Industriousness vs. our even greater admiration for leisure.
7. Always keep improving yourself vs. accept your short-comings and learn to live with them.
8. A handicapped child should be treated like any normal child and yet be given special aids.
9. Cleanliness and meticulous accuracy vs. casual attitudes to life's responsibilities.
10. We teach our children self-reliance and individualism while also teaching team-work and cooperative efforts in groups.
11. We disapprove of corporal punishment but have we clearly articulated its appropriate substitute in discipline?
12. We glorify freedom of marital choice but do we provide teen-agers with the requisite preliminary phase of freedom of dating choices?
13. We treat our small children alternately as little Demons, little Saints of Purity, or Fallen Idols when they slip off the pedestals we have erected for them.

These are only a few among many—but out of all of these I think we can distill an essence consisting of a few major cross-currents of conflict in our values pertaining to child and adolescent development.

1. The problem of permissiveness. The penetrating wisdom of John Dewey and Sigmund Freud gave the world a few great insights into the child's needs and inner make-up leading us to self-demand feeding of infants, training children only after they are age-ready or properly motivated, helping

and permitting children to express their hostilities with a minimum of guilt feeling, etc. *But* they didn't imply freedom to attack others or to retrogress in their developmental curves without direct intervention.

2. In answering our youngsters' questions do we *differentiate* for them questions of fact, from questions of cultural values, from questions for which there are no answers—*before* we seek to *answer* them? And do we help the child evolve his own answer by showing him the alternatives, the implications of each choice in an unexcited manner? Isn't our vaster experience in living more applicable to show *consequences* of actions rather than deciding for the child, thus fostering his further dependency upon us?

3. Do we accept a child *as he is* with no *"ifs"* or *"buts"?* Parents find this very difficult.

4. Can't we teach our children to accept change and derive their security from confidence in their own ability to adapt themselves to change, rather than depend like cowards for their security on keeping everything status quo.

Heraclitus, the Greek philosopher, cast a long shadow before him when he said: "One cannot step in the same river twice." The river is changed and so does the one who steps in.

Change does not terrify the scientist. It terrifies only those who, in planning their lives, leave it out of account. Inculcating absolute values to our children in a democracy leads to fear of change, resistance to change, and hostility to those proposing it. Maybe we need to teach a *few* absolute values—a few won't hurt!

Finally in this regard, I'd like to add that a democratic society, or parent, or teacher, ideally reacts to the young person according to this formula:

You're great despite your faults. If you obey you *may* attain rewards.

If you disobey you will lose rewards.

The autocratic attitude to the child (and many parents and teachers are islands of autocracy in our otherwise basically democratic social order) says, in effect: You'd be great if you eradicated your faults.

If you obey you *will* attain rewards.

If you disobey you will be punished.

At the risk of taking too much time let me make one more plea—a plea that we concentrate our psychodynamic knowledge and tools on prevention rather than on treatment. Why not view all our ameliorative efforts as a great laboratory for elaborating practicable hypotheses for early diagnosis and prevention of emotional disturbance? Several hours of mental hygiene counseling to a group of teen-agers or young couples might produce better

results than the 1000 psychoanalytic hour spent later on with one seriously disturbed adult. We are not sufficiently alert to the first signs of emotional growth failure. For when a child or adolescent stops marching forward he retrogresses rapidly, and no living thing remains unchanging. Practically speaking, why not use emotional and social achievement tests at the end of each school year much as we use academic achievement tests?

In summary and in closing, may I leave a thought with you for the decade that lies ahead?

Our youngsters are bearers of our traditions, our values, our liberties. As such they deserve more than schooling, pasteurized milk, and treatment for their emotional disturbances *in being*. They deserve the *fullest* implementation of our psychological knowledge and techniques (inadequate as they still are!) to the broader horizons of *preventing* mental disorders and building towards a program of *positive* mental health. This is not Utopia, a fool's pipe-dream, or an unachievable Paradise on Earth! It is the minimal birthright and just demand of every American child and youth.

Department of Education
Montclair State College
Upper Montclair, New Jersey

The Journal of Genetic Psychology, 1963, **102**, 51-54.

VISUAL STIMULI ELICITING THE SMILING RESPONSE IN THE HUMAN INFANT*

Department of Zoology, University of Liverpool

E. A. SALZEN

The smiling response is perhaps the first social behavior pattern to appear in the developing human infant. In a study of 185 babies Jones (7) reported that social smiling in response to the human voice or face first appears between the end of the first and third months, although smiling in response to noises of almost any kind occurs before this time and reflex smiles in response to tactual, organic and kinesthetic stimuli may appear as early as the first week. It is possible that in this last case the smiles are the "gastric smiles" described by Gesell and Amatruda (3), so that there seems little doubt that smiling in response to a visual stimulus first occurs at about eight weeks of age. Furthermore, this response has usually been elicited by the face of the observer who may himself smile or speak. Spitz and Wolf (10) found that a face-like mask would also produce this response in babies between the ages of two and six months, even when the mask was simply a piece of cambric with two eye-spots, provided that there was some movement and that it was presented "en face." In contrast with this, objects of various textures, sizes, colours and shapes totally failed to elicit smiling when presented to the same babies. It is generally assumed, therefore, that a face-like configuration is a necessary visual stimulus for the smiling response. However, Spitz and Wolf state that before the third month smiling may be of the nature of an indiscriminate overflow response and that it is only by the third month that the smile becomes a reaction distinctly linked to certain stimuli. My own observations of a baby, made before the human face had become a necessary visual stimulus for the smiling response, suggest that the first visual stimulus for this response may simply be any contrast or change in brightness in the visual environment.

When seven weeks old this baby was seen to smile at external stimuli in a manner quite distinct from the "gastric smile" which occurred without apparent relation to external events. At the same time the baby was beginning to fixate and track moving objects. When eight weeks old her smiles were quite distinct and definite and were seen to occur on the following

* Received in the Editorial Office on January 24, 1961.

occasions: when she was apparently looking at a window in daylight, when looking at electric lamps which were alight, and on one occasion when looking at the white inside of the hood of her carry-cot. At the same stage the baby would also smile at the human face especially when this was oscillated from side to side. Similar smiles could be obtained by presenting cardboard ovals about 13 inches in length, whether these were white, black, or white with black rim. Oscillation of these stimulus objects again appeared more likely to elicit a smile. Finally an electric torch with a two-inch diameter reflector produced a similar response whether flashed on and off repetitively or constantly on. Again the intermittent stimulation of the flashing light seemed the more effective stimulus. All these stimuli were presented by hand 2–3 feet above the baby when she was lying quietly, either after feeding or after waking but before feeding cries occurred. The observer kept low down and to one side, or at the head of, the carry-cot, as much out of sight as possible. The test objects were presented only when the baby was looking up and was not aware of the observer. All stimuli were presented several times and in varied order on several occasions during the eighth week. Two days after these observations had begun another stimulus card was introduced. This was a similar white cardboard oval but with eight black sectors radiating from the centre and approximately equal in area to the intervening white sectors. This proved a very effective stimulus, especially when rotated either in an oscillatory or in a one-directional manner. So effective was this stimulus that the baby would stop her food cries, or her feeding, and watch quietly with smiles for several minutes. None of the other stimuli, including the human face emitting any manner of coaxing noises, would serve to stop the same food cries when this stimulus was removed. In this respect it is worth recalling that Spitz and Wolf found that even during the peak of their smiling response period (2–6 months) crying infants would not respond to the human face.

All these stimuli continued to elicit smiling when presented to the baby during the ninth and eleventh weeks. In the latter week talking appeared to help in producing a smile when the human face was presented. In the twelfth week none of the cardboard ovals elicited a smile, even when they were held in front of the observer's face and accompanied by talking. Yet another combination of sight and sound, such as a shaken rattle or tin of pins, would make her smile and in the thirteenth week a clock with a moderately loud tick proved a reliable stimulus for the smiling response.

These observations suggest that the smiling response may be first elicited not by a complex stimulus pattern such as a human face but simply by any

contrast or change in brightness, the former being spatial contrast and the latter temporal contrast. The fact that both black and white cardboard ovals would produce smiling agrees with the finding of Berlyne (1) that albedo differences did not affect the extent to which certain stimulus patterns would produce visual fixation in babies. Berlyne found that black dots randomly distributed on a white ground and a small black and white checkerboard pattern were most effective in producing fixation and he suggested that this was related to the role of contour in the vertebrate eye in motion by traversing or by physiological nystagmus. The result recorded here for the striking effectiveness of a rotated black and white sectored disc in producing the smiling response is in full accord with this suggestion. It would seem that the simple, physiologically effective visual stimulus is also sufficient stimulus for the first smiling responses of the human infant. The few observations given here concerning sounds suggest that the same is true for them. Munn (8) reports that in the study carried out by Hetzer and Tudor-Hart (5) smiling occurred indiscriminately to noises of various kinds but that at eight weeks the human voice began to be more effective than other sounds. In the present study a complex pattern such as a speaking human face appeared to become a necessary stimulus for smiling when this particular baby was eleven weeks old. Even at this stage she would also smile at her rattle and teddy bear and at later ages would smile when presented with her teething ring. At her present age of six months she smiles whenever one or other of her two teddy bears is shown to her. It is strange therefore that none of the 145 babies studied by Spitz and Wolf would smile at toys or a rubber doll, nor would any of them smile when presented with his or her own particular rattle. Spitz and Wolf also tried simple non-human stimuli, such as pieces of cardboard and even a flashlight but failed to elicit smiling. In view of my results it is surprising that not even the youngest of their subjects would respond to such stimuli, especially as the objects were presented by hand in a broadly similar fashion in both the studies. There is a case, therefore, for someone who has access to numbers of infants to re-examine the nature of the stimulus situations which elicit smiling at various ages.

It is interesting to note that simple stimuli which are similar to those described in this present paper and which include intermittent sounds with low frequency components, reported by Collias (2), a flashing light, reported by James (6) and Smith (9), and a rotating white disc with a single black sector, reported by Smith (9), are sufficient stimuli for the first approach responses of domestic chicks. A complex pattern such as that of a

hen or of a moving object is not a necessary stimulus for such responses in the first instance. As with the human infant, however, complex stimulus patterns may become necessary with further visual experience. This change in the nature of the necessary stimulus in chicks has been called "imprinting." It is of further interest, therefore, that Gray (4) has proposed that the smiling response in human infants is the motor equivalent of the following responses in chicks. Similarities between the development of social responses in chicks and children are expressed when the term "imprinting" is applied to them both. It may well be that such similarities are due to the characteristics of the higher vertebrate visual and auditory systems which they have in common.

References

1. Berlyne, D. E. The influence of the albedo and complexity of stimuli on visual fixation in the human infant. *Brit. J. Psychol.*, 1958, **49**, 315-8.
2. Collias, N. E. The development of social behaviour in birds. *Auk.*, 1952, **69**, 127-59.
3. Gesell, A., & Amatruda, C. S. The Embryology of Behaviour. London: Hamish Hamilton Ltd., 1945.
4. Gray, P. H. Theory and evidence of imprinting in human infants. *J. of Psychol.*, 1958, **46**, 155-66.
5. Hetzer, H., & Tudor-Hart, B. H. Die Fruhesten Reactionen auf die Menschliche Stimme. *Quellen und Studien.*, 1927, **5**, 103-24.
6. James, H. Flicker: An unconditioned stimulus for imprinting. *Canad. J. Psychol.*, 1959, **13**, 59-67.
7. Jones, M. C. The development of early behaviour patterns in young children. *J. Genet. Psychol.*, 1926, **33**, 537-85.
8. Munn, N. L. The Evolution and Growth of Human Behaviour. Boston: Houghton Mifflin Co., 1955.
9. Smith, F. V. Towards a definition of the stimulus situation for the approach response of the domestic chick. *Anim. Behaviour*, 1960, **8**, 197-200.
10. Spitz, R. A., & Wolf, K. M. The smiling response: A contribution to the ontogenesis of social relations. *Genet. Psychol. Monogr.*, 1946, **34**, 57-125.

Department of Zoology
University of Liverpool
Liverpool, England

The Journal of Genetic Psychology, 1963, **102**, 55-60.

A NOTE ON AN ATTEMPT TO INDUCE A SCHIZOPHRENIC-LIKE STATE IN KITTENS*

Veterans Administration Hospital, Northport, New York

EMANUEL STARER, IRVING J. BLUMENTHAL, AND TOM T. IRIYE

A. INTRODUCTION

It has not been possible to produce schizophrenia in animals although, by drugs and other means, certain schizophrenic-like reactions have been produced experimentally in them as in man (2). In this investigation an attempt was made to induce a schizophrenic-like state in kittens. The assumption was made that schizophrenia in humans results from a severe stress upon the infant as a result of the mother's unconscious rejection of it. This rejection is manifested primarily during the feeding process and serves as a "death threat" to the infant. Depending upon the constitutional ability of the infant to withstand the intense stress, symptoms such as "a break with reality, loss of faculty for communication, emotional withdrawal, lack of capacity for abstraction, and disintegration of the ego" may develop. This assumption is consistent with the approach of Will (5). He stated that he considered the early life of the schizophrenic person to be marked by unhappiness, emotional insecurity, and severe anxiety, present before the child has developed adequate methods of dealing with those who cared for him and before he is able to gain corrective help from people outside of the family circle.

In the experiment performed by Pechtel, Masserman, and Aarons (3), kittens, adult rats and monkeys were shocked at irregular periods by subjecting them to two to 10 low amperage, high voltage condenser shocks at the time of food taking over a period of 3–15 weeks. However, these shocks were begun, apparently, after the kittens had been weaned.

B. EXPERIMENTAL METHOD

In the present investigation the experimental kitten was given 5000 electrical shocks to its rear legs. This was administered by an inductorium with a .6 milliampere current and 72 volts being applied. The shocks were administered seven days after birth and continued through the next 35 days. They were introduced gradually ranging from two on the first day to as

* Received in the Editorial Office on January 30, 1961.

many as 700 per day during the final period. These shocks were administered during the nursing period and later on only when the experimental kitten was in close proximity to the mother or the control kitten.

Originally, six experimental and six control kittens were available. However, one mother cat developed pneumonia and this led to her death as well as all her offspring. Other kittens developed virus conditions and died leaving only one experimental (male) and one control (female) alive. The behavior of both kittens was closely observed during the experiment and was eventually rated by three independent observers. Maze learning tests were given, electroencephalographic records were taken, and biochemical studies were performed on both kittens.

C. Results

1. *Behavioral Differences*

Some of the behavioral manifestations of the experimental kitten included marked withdrawal, a tendency to go "to sleep," which was in sharp contrast to the control kitten's wide-awake attitude, marked ambivalent trends such as wanting to go toward the mother cat and then suddenly retreating toward a "safe corner" of the cage, and a tendency at times to become overly aggressive toward its sibling.

In the photograph the experimental kitten is seen in the right foreground, withdrawn and almost "apathetic." In the right rear of the cage is another experimental kitten (female) which unfortunately died before the final tests could be conducted. This kitten is seen to be withdrawn and in a "sleep-like" state.

The control kitten appeared to be relatively congenial, playful, and generally at ease. No unusual behavioral phenomena could be noted by the three independent observers who evaluated the behavior of the control kitten at the conclusion of the experiment. Each of the three observers was able to determine almost immediately which kitten was the control and which the experimental during the standard 15-minute observation period.

The behavior of the mother cat, although not part of the experiment, merits attention, since it may give a clue as to why schizophrenia is apparently absent in cats and similar animals. When she eventually discovered that the experimental kitten was being given electric shocks during the feeding process or whenever it was close to her body, she would do everything possible to thwart the experimenters with her claws, then trying to bite the electrode wire, and finally actually leaving the experimental kitten and running as far away as possible whenever the electrodes were on the

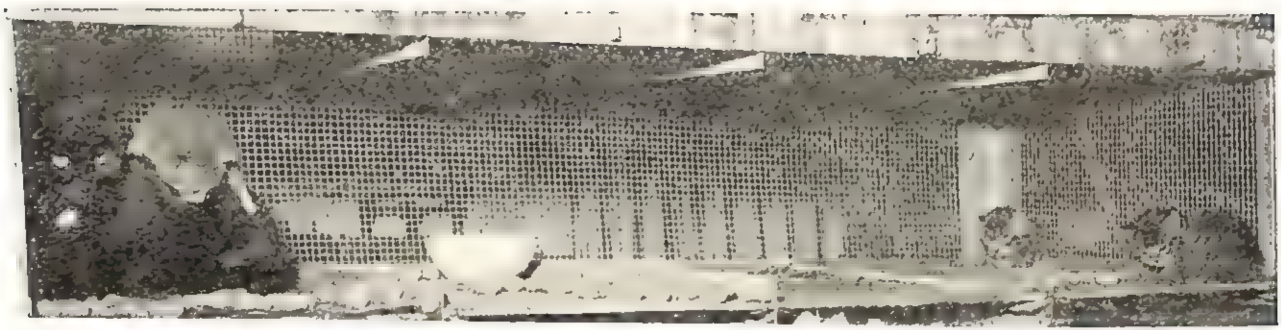

FIGURE 1
EXPERIMENTAL KITTENS ARE ON RIGHT SIDE. CONTROL KITTEN IS RESTING ON MOTHER

kitten's legs. Her attitude toward the experimental kitten when the electrodes were removed was one of "deep mother love." She would run over to the kitten, try to feed it or else comfort it as much as possible. It is hypothesized that the attitude of mother cats and other similar animal categories toward their young is either one of healthy mother love or else of outright rejection. The latter attitude will of course lead to the death of the young one and probably occurs only rarely and under most unusual circumstances. This is in contrast to the human species where in addition to the expected mother reaction, complex stresses such as psychological, economic, social, and religious among others may serve to cause marked ambivalence on the part of the mother toward her child.

2. *Follow-up Period*

No electrical shocks were administered to the experimental kitten for a period of 74 days. At the end of that time observation of the behavior of the experimental and control kitten showed no apparent differences between them. Both were then subjected to 10 minutes of the sounding of the buzzer of the inductorium, following which each was given two shocks, with a .6 milliampere current and 72 volts, to their rear legs. The experimental kitten thereupon showed a marked change in behavior, becoming withdrawn, apathetic, and showing sleep-like behavior, as well as occasionally displaying unexpected aggressive reactions. The control kitten continued to be playful, alert, and active. Some retaliatory reaction on the part of the control kitten in the form of striking back with its claws was also noted.

3. *Maze Learning Tests*

The results of the maze learning experiments where the kittens had to learn to make a left turn, followed by a right turn, indicate that the control kitten was able to learn this simple task more efficiently than the experimental kitten. However, when the experimental kitten was made to feel less anxious and more secure, by covering the top of the maze with a grid, it was able to run the maze practically as quickly and as accurately. It must be realized, however, that the maze employed was very simple in nature and that with a more intricate maze different results might have been obtained.

4. *EEG Results*

Electroencephalograms taken of the experimental kitten revealed no evidence of seizure activity after 5000 shocks. Follow-up recordings taken after a period of seven weeks and again after three months did not show seizure

activity electrographically. No clinical seizures were noted at any time during the experiment.

5. *Biochemical Results*

As a collaboratory experiment in the study of behavioral patterns of the kittens subjected to electrical shocks described above, the excretion of catecholamines was determined in 24-hour urine by a modification of the method of Sobel and Henry (4). Attempts were also made to determine 17-ketosteroids by a modified Zimmerman-Callow procedure (1) whenever enough specimens of urine were left over from the above catecholamine determinations. The experiments were done immediately after the initial phase of electric shocks. The results of catecholamine determination are given in Table 1.

TABLE 1
URINARY EXCRETION OF CATECHOLAMINES IN 24-HOUR URINE (IN MICROGRAMS)

Sample no.	Date of collection	Control	Experimental	Difference
1	June 9	0.44	1.35	+0.91
2	14	2.93	0.79	—2.14
3	17	—*	2.69	
4	22	3.46	10.70	+7.24
5	24	1.81	5.98	+4.17
6	28	1.99	3.96	+1.97
7	30	5.75	8.40	+2.65
8	July 6	3.96	4.70	+0.74
9	8	3.02	1.35	—1.67
10	12	2.52	1.66	—0.86
11	14	1.15	1.85	+0.70

* No specimen.

The table indicates a trend of higher values in the experimental animal during the earlier days of urine collection. However, corroboration of this finding, using a larger sample, would be advisable before any conclusion can be drawn.

As for the 17-ketosteroids, with a limited number of specimens, the available figures showed no discernible trend.

D. SUMMARY AND CONCLUSIONS

An experimental kitten was given 5000 electrical shocks to its rear legs, with a .6 milliampere current and 72 volts. The stimulation was begun seven days after birth and continued through the next 35 days. The experimental kitten tended to withdraw, showed frequent apathy and "sleep-like" behavior, and at other times become excessively aggressive. This was

in marked contrast to the control kitten's behavior which was generally attentive, "pleasant" and tractable. No significant difference was noted in a relatively simple maze problem once the experimental kitten's anxiety was lessened.

During a follow-up experiment, it was noted that even under very mild stress, the experimental kitten tended to resume its previous schizophrenic-like behavior. Were very severe stress to be applied, it is assumed that the behavior would tend to break down even more precipitously.

No seizure activity, electrographically or clinically, was observed in the experimental kitten.

The results of the catecholamine studies showed an increase for the experimental kitten. In the ketosteroid studies, with a limited number of specimens, no discernible trend was found. However, corroboration of these findings, using larger samples, would be advisable before any conclusions can be drawn.

E. Acknowledgments

The authors desire to express their appreciation to Andrew Kuna, Ph.D., Biochemist, for his collaboration. The technical assistance of the following personnel is also acknowledged: Andrew Dunn, B.S., Electroencephalograph Technician; Francis Simmonds, B.S., Junior Biochemist; Theodore Willers, Chief, Medical Illustration Service.

References

1. Callow, N. H., Callow, R. K., & Emmens, C. W. *Biochem J.* **32**: 1312, Aug. 1938.
2. Lape, E. E. Medical Research: A Midcentury Survey. Volume II, Boston: Little, Brown & Co., 1955.
3. Pechtel, C., Masserman, J. H., & Aarons, L. *Am. J. Psychiat.* **116**: 1018, May 1960.
4. Sobel, C. & Henry, R. J. *Am. J. Clin. Path.* **27**: 240, 1957.
5. Will, O. A., Jr. *J. Nerv. & Ment. Dis.*, **126**: 109, Feb. 1958.

VA Hospital
Northport, Long Island
New York

The Journal of Genetic Psychology, 1963, **102**, 61-67.

AN EXPERIENCE WITH GROUP HYPNOSIS IN READING DISABILITY IN PRIMARY BEHAVIOR DISORDERS*

Central Islip State Hospital, New York

JOSEPH ILLOVSKY[1]

A. PURPOSE

The purpose of this six months study was to find out how group hypnosis would influence the reading ability of adolescents in the Boys' Unit in Central Islip State Hospital. The selected youngsters were between the ages of 15 and 16. They had been hospitalized for social maladjustment: truculence, insubordination and juvenile delinquency. At the time of the study all but one, No. 5, had been in the hospital for more than one year. They had been taught the previous year by the same teacher who took part in this experiment.

B. METHOD

The curriculum consisted of three hours of academic work a day—generously interspersed with recreational activities and handicraft. The boys were divided into small groups of seven or eight, according to their educational level.

1. *Subjects*

The 12 worst readers in the Unit were chosen to take part in the experiment. Prior to this study, they had never been hypnotized. The curriculum and the teaching methods remained unchanged from the previous year.

2. *Procedure*

After the boys' reading ability was ascertained through Gray's Oral Reading Paragraphs, they were put in comfortable arm-chairs. A working rapport was established with them by talking about their difficulties in reading and the possibility of an easy method in learning.

Everybody was interested and serious. They were told to clasp their hands together as in prayer and to imagine that they had been travelling

* Received in the Editorial Office on February 27, 1961.

[1] The author wishes to tender his thanks to Dr. Marshall Merkin, Supervising Psychiatrist in the Boys' Unit, Central Islip State Hospital, for permitting the experiment; Mr. Myron Demcio, Psychologist, for the repeated psychological tests and cooperation; Mrs. Dorothy F. Shearman who taught and observed the boys in school.

for days and were extremely bored. They were asked to gaze steadily at the point where their thumbs crossed. Then they were told to tighten their eyelids, and at the same time to keep their eyeballs rolled up, while the writer counted from one to ten.

Their cooperation was tested by suggesting to them that their eyes were shut so tight that they could not open them. Then, they were requested to clasp their hands together so tight that they could not separate them. Consecutively, rigidity, lightening and sensation of weight in the right arm were suggested. Visual hallucinations were inducted by asking them to imagine a church bell swinging slowly and auditory ones by listening to the sound of the bell.

All but two cooperated well and reached all these stages at the first session. These two were eliminated. To speed up future inductions, the post-hypnotic suggestion was given to fall asleep at the count of ten at the next session. The remaining ten boys were divided into two groups. Boys 1, 2, 3, 4, 5, were hypnotized before classes three times a week and then sent to school with boys I, II, III, IV, V, who were not hypnotized and both groups were taught together.

The hypnotized group received suggestions for 15 to 20 minutes at a time. They were told:

> Relax . . . your mind feels as keen as the edge of a razor . . . at the same time, it is as soft as the finest wax that can preserve the impressions of the words and letters as sharply and clearly as if they were cut in a sheet of glass with a sharp diamond. . . . You will remember those letters and words and recognize them when you see them somewhere else. . . . This will make you feel good, because you want to read as anybody else does in your community . . . because you will get better pay if you can read. . . .

For the first 10 sessions, it was suggested that they could open their eyes although still asleep and read aloud from a chart of 15 three-letter words shown to them by the teacher. They were told that at the sound of a hand-clap they would be wide awake and would continue reading and remembering the letters and words. When they reached the middle of the chart, I clapped my hands and they became lively but continued reading.

To enhance their concentration in class, they were given the post-hypnotic suggestion that when the teacher said, "Boys, let's read," their mind would feel "as keen as the edge of a razor, etc." The teacher noticed on those occasions that the boys suddenly became serious and some of them smiled faintly and then concentrated on their reading. It is worth noting that the hypnotized groups required repeated reading over a few hours.

After the first few sessions additional ideas had to be incorporated into suggestions to combat interferences. The boys were told:

1. Not to be bothered by the presence of others but to be proud of their reading group and to take pride in helping others with reading.
2. Instead of thinking of the family problems, they should concentrate on their reading and plan for their future when they become bigger and can lead their own lives.
3. That as soon as they entered the room, they would feel drowsy and relaxed as if they were going to sleep.

The latter suggestion was necessary because after the first few sessions on entering the room they used to "act up." They wanted to finish their cigarettes, teased one another or slid all over the room pushing the armchairs like sleighs.

Sometimes recent family troubles, fights in the ward, and the resulting restriction of liberty had interfered with their smooth cooperation. But the suggestion of drowsiness on entering the room and repeated suggestion of relaxation soon calmed them.

After three months, the writer was transferred to another unit and was not about the ward all day. He saw the boys only during the short morning hypnotic sessions. Their knowledge of the approaching end of the experiment had also made them restless before the sessions and the length of the induction had to be increased to reach the desired depth before the usual suggestions could be given. They were also less cooperative in the classroom during the last two months of the experiment. But the conditioning of the first three months was strong and they continued to cooperate though to a lesser extent than during the first three months.

C. Results

Before the experiment started, the boys had an intelligence test. See Table 1. House Tree and Person test and Draw a Person test were administered by the Psychologist of the unit at the beginning of the experiment and the tests were repeated after three months, at the end of six months and two months after the last hypnotic session. The test material was interpreted by five psychologists of the Psychology Department of the hospital. None of them knew the boys. They all agreed that both the hypnotized and the control group had their best ego-integration at the end of the first three months; the least at the end of the experiment. The last tests, two months later, showed an increase in the integration in both

TABLE 1
The Arabic Numbers Indicate Boys of the Hypnotic Group.
The Roman Numbers Those of the Control Group
FSIQ = Full Scale I.Q.; Verb. I.Q. = Verbal I.Q.
Perf = Prrformance

Boys	Intelligence tests FSIQ	Verb. IQ	Perf. IQ
1	80	74	90
2	108	96	114
3	77	61	76
4	75	77	78
5	90	89	99
I	67	67	74
II	86	80	96
III	88	87	92
IV	46	53	48
V	92	93	92

groups. The tests were done to see how a forced conditioning in reading may influence the ego structure of the hypnotized group. It is worth noting that at the third month test boys No. 4 and 5 drew only the outline of the face without features. Besides this, the tests showed no difference between the two groups.

The teacher called both groups "non-readers," with an extreme lack of self-confidence. These were boys who could work only when the teacher was at their side. After the first 10 lessons with the charts each hour was started with group work—two boys read together—and then individual reading with a student nurse beside each boy followed. It was noticed that the hypnotized group showed greater readiness to attack new work and very little lasting discouragement in spite of being slightly weaker intellectually than the control group. The hypnotized group could be handled more easily and worked in pairs better than the control group. It is noteworthy that among the 10 boys, only one, No. 1, of the hypnotized group could recognize that the reading tests were the same on all occasions. For final results, see Table 2.

D. Discussion

The experiment showed that recalcitrant children can be repeatedly hypnotized in group when sufficient motivation is given to cooperate. The results showed that boys 1, 2, 4 and 5, from below the first grade level gained an average of two years and three months in their reading ability during the six months period of the experiment; while the control group gained an average of nine months.

No. 3 of the hypnotized group was a severely withdrawn and frightened child, the smallest and the thinnest in the group. He always sat at a distance from the others and complied with all suggestions meekly. The impression was that the amount of motivation given to the others was not enough for him. He would have required individual attention to increase his self-esteem and provide him with motivation to study; for, he felt that since his mother did not care for him, everything was hopeless. His only motive for cooperation was the peace and quiet during hypnosis when nobody bothered him. In class he was lackadaisical, played with his books and did little work; hence, the little progress from his previous level of reading. His improvement after the experiment was over was caused by the fact that his mother started to visit him and took him home for week-ends with a view to impending discharge from the hospital.

Boy No. II, of the control group was alert but easily distracted and for this reason, he also failed to improve, before, during and after the experimental period.

It is noteworthy that boys No. 1 and No. 5 of the hypnotized group believed that through the magic of hypnosis they needed no effort on their part to learn. This may be the reason that after the experiment was over, they failed to maintain their significant improvement. On the other hand, Nos. 2 and 4, who frequently protested against the discipline of hypnosis, were satisfied with their progress, permitted a motivated "conditioning" and so continued with their progress even after the experiment was over.

These two reaction forms correspond to Rado's classification of behavior during treatment. (*a*) The magic craving group which is lost without the therapist and must continue with hypnosis for a longer period and the sessions have to be tapered off gradually to allow them to carry on with the new behavior on their own. (*b*) The self-reliant group, which required only a "push" of a short three to four months of hypnosis to induce in them a new pattern of behavior. With these, the resulting satisfaction in their achievement increases the self-confidence and permits them to carry on without further help.

The reading experiment with these few boys showed that hypnosis through its well-known hypermnesia can maintain or even enhance the reading ability of the hypnotized subjects even if it is done under group hypnosis instead of individual one. The advantage of this method lies in the fact that more subjects can be handled at the same time. The group gives more self-confidence to the individual, alleviates his possible fears and so increases the cooperation to be hypnotized. The suggestions then do the rest.

TABLE 2

Below Grade 1 Indicates That the Only Means to Determine the Reading Ability Was the Number of Errors. The Numbers Before the Decimal Points Indicate Years and After It Months (e.g., 3.2–3 Years and 2 Months)

Boys	Reading tests			
	Initial	at 3 months	at 6 months	at 8 months
1	below Grade 1; 30 errors	14 errors	2.4	2.3
2	below Grade 1; 24 errors	1.4	1.8	2.3
3	3.1 months	2.4	3.2	3.7
4	below Grade 1; 13 errors	2.4	2.3	3.1
5	below Grade 1; 11 errors	1.8	2.9	2.9
I	below Grade 1	1.4	1.8	2.1
II	below Grade 1; 20 errors	11 errors	25 errors	23 errors
III	1.8 months	1.6	1.9	2.1
IV	3.2	3.2	3.6	3.7
V	below Grade 1; 22 errors	16 errors	1.4	discharged

E. Summary

The purpose of this six months study was to find out how group hypnosis would influence the reading ability of the worst readers in the Boys' Unit in Central Islip State Hospital. Five boys between the ages of 15 and 16 were hypnotized together before classes and received suggestions to increase their retentive power towards the reading material. Another five boys were taught by the same teacher in the same classroom with the same method for the same length of time without hypnosis. The hypnotized group during the six months of the study had gained an average of two years and three months in their reading though they were slightly weaker intellectually than the other five boys. The control group during the same period had gained an average of nine months. The hypnotized group showed greater readiness to attack new work, very little lasting discouragement and more ability to study together with other boys than the non-hypnotized control group. Those boys who considered hypnosis as magic, which required no effort on their part, showed great improvement during the period of suggestion but failed to maintain it after the sessions were terminated. The other boys

who were more self-reliant needed only the "push" of hypnosis to continue with their improvement even after the suggestions had ceased.

Simultaneous hypnosis of the five subjects had increased significantly their reading ability through hypermensia. This method had saved time of the therapist and teacher, increased the subjects self-confidence because of being in a group, alleviated their fears and so increased their cooperation to get hypnotized and accept the suggestions.

References

1. Rado, S. Psychoanalysis of Behavior—Collected Papers. New York: Grune & Stratton, 1956.
2. Rhodes, R. H. Hypnosis: Theory, Practice and Application. New York: Citadel Press, 1950.
3. Tagot, P. C. Theories et Procedes de L'Hypnotisme. Paris: Editions D'Angles, 1936.
4. Wolberg, L. R. Medical Hypnosis. New York: Grune & Stratton, 1948.

Creedmoor State Hospital
Queens Village 27, New York

The Journal of Genetic Psychology, 1963, **102**, 69-74.

RESPONSE TO HANDLING AS A FUNCTION OF SEX AND EMOTIONAL DIFFERENCES IN THE ALBINO RAT*

Department of Psychology, University of North Dakota

LeRoy A. Stone and Clifford S. Knutson

A. Problem

Emotional elimination (defecation and micturition) has been long used as an indication of emotionality in the rat (10, 15). Hall (4) began validity studies of emotional elimination in a somewhat standardized situation, the open-field test. He believed that eliminative behavior in the open-field situation was related to fear. Criticism of his technique has been made because the technique has not always correlated with other proposed measures of emotionality or timidity (1, 6, 7). Contradictory results pertaining to sex differences in the open-field test have been reported (2, 3, 4, 8, 12, 14).

Degree of ambulation in the open-field situation has been found to be sexually differentiated, with females more active than males (2, 11). Broadhurst (2) suggests that females generally demonstrate a greater reactivity to situational stimuli than do males. Working with conditioned emotional responses in the rat, Singh (9) found that females were more susceptible to fear conditioning than were males. It has been suggested by Tryon (13) that if a behavior difference between the sexes exists, it probably is in emotional domains.

The purpose of the present study was to examine sex related differences in response to handling in the albino rat. Difference in response to handling and its relationship to frequency of urination and defecation in a stress situation was also studied.

B. Method

1. *Subjects*

The subjects were 113 albino rats (61 females and 52 males) of the Sprague-Dawley strain obtained from the animal colony of the Psychology Department at the University of North Dakota. Prior to the actual testing, the subjects had been handled only once before. This first handling occurred

* Received in the Editorial Office on February 13, 1961.

when the subjects were approximately 21 days old, when they were weaned, sexed, and caged in groups of two or three. At the time of the present study, the subjects were not only experimentally naive but had only undergone this minimum handling. The age of the subjects ranged from 102 to 141 days old. Sex membership was well distributed along this age range. Since weaning, the subjects had been housed in 11 inch by 8-1/4 inch by 8-1/4 inch Wahmann cages, watered on tap water, and fed with Purina Laboratory Chow.

2. *Procedure*

The cages housing the subjects were randomized according to a table of random numbers and the order of examination was in accord with this randomized order. Three judges (two handlers and one recorder), familiar with the routine handling of laboratory rats, handled the subjects and judged whether the subjects were cooperative or uncooperative during handling. Uncooperative response to handling was defined as attempts to escape the handler's grasp by rapid movement in the home cage and/or by strong efforts to escape (squirming and pushing) after having been grasped.

The procedure involved removing a subject from his or her home cage and placing the subject in a 12 inch by 8-1/4 inch by 10 inch cage equipped with clean white paper on the floor for a period of one minute. Response to handling was recorded starting from initial handling behavior in a home cage to placement in a testing cage. Handling between cages generally took about 10 to 15 seconds. Urination and defecation were recorded starting with handling and ending after one minute in the test cage. Defecation and urination were recorded according to frequency. The paper flooring in the test cages was changed after every subject. The handling order for the two handlers was randomized according to a table of random permutations and all handling was in this order. The order of voting by the three judges was also somewhat randomized, the recorder and the non-handler always cast their votes in a randomized order with the handler casting the third and possibly decisive vote. In this manner, the handler was in a position to cast the most influential vote. An attempt was made to handle all animals equally and in a gentle manner. By being able to overlap handling and testing, two or three subjects were tested during a common period of time. All handling, testing, and recording was accomplished during a three hour period.

In order to test the inter-reliability of the judges, an additional 25 animals were randomly selected from the colony and were handled and tested in

the described procedure. The three judges rated the animals by a triple classification, cooperative response to handling, uncooperative response, and a middle rating between the two extremes. From these ratings, a Kendall coefficient of concordance, corrected for ties, was computed to test the inter-reliability of the judges. Even with this more difficult triple classification, a high agreement between judges was observed as evidenced by a significant Kendall coefficient of concordance ($W = .88$, $p < .001$).

Because of the nominal level of measurement involved in the remainder of the study, statistical analysis was limited to chi-square and its related contingency coefficient.

C. Results

The male-female dichotomy was examined separately regarding cooperative-uncooperative response to handling, defecation-nondefecation, and urination-nonurination. This resulted in three 2×2 tables which were tested by chi-square (corrected for continuity). Inspection of Table 1 indicates that cooperative-uncooperative response to handling was significantly differentiated by sex membership, with female animals more uncooperative (chi-square 3.96; df 1; $p < .05$).

TABLE 1
Response to Handling and Sex Membership

Sex	Cooperative	Uncooperative	Total
Male	40	12	52
Female	35	26	61
	75	38	113

Note.—Chi-square 3.96; df 1; $p < .05$.

Defecation-nondefecation and urination-nonurination appeared not to be differentiated by male-female membership. Defecation-nondefecation was unaffected by sex differences (chi-square .01; df 1; $p > .90$) and urination-nonurination was likewise unaffected by sex membership (chi-square 1.06; df 1; $p > .30$).

Contingency coefficients were computed between defecation-nondefecation and urination-nonurination, between cooperative-uncooperative response to handling and defecation-nondefecation, and between cooperative-uncooperative response to handling and urination-nonurination. These coefficients are presented in Table 2.

The only significant contingency coefficient found occurred between cooperative-uncooperative response to handling and urination-nonurination $C =$

TABLE 2
CONTINGENCY COEFFICIENTS BETWEEN HANDLING RESPONSE, URINATION RESPONSE, AND DEFECATION RESPONSE

Responses	2	3
1. Cooperation-noncooperation	.05	.28*
2. Defecation-nondefecation		.12
3. Urination-nonurination		

* Chi-square 9.33; *df* 1; $p < .01$.

.28; chi-square 9.33; *df* 1; $p < .01$). This coefficient suggests that uncooperative response to handling and urination during handling or shortly after handling tend to occur together. Defecation during handling or shortly after did not appear related to uncooperative response during handling. The incidence of defecation during handling or shortly after was not significantly related to urination during handling and in the one minute period following handling.

D. Discussion

The finding of differential response to handling seemingly related to sex membership, with females demonstrating more uncooperation, agrees with Broadhurst's (2) contention that females show a greater reactivity to situational stimuli. This has some practical implications when it is considered that many rat behavioral experiments depend upon differential response soon after handling. Bias might be introduced into some experiments if sex membership is not controlled. It has been suggested by Homme and Klaus (5, p. 2) that young female rats be used for introducing beginning students to animal learning procedures and also for use in class demonstrations because females are "smaller and less aversive in appearance." However, considering the observed differences in response to handling, male rats might be preferred when introducing beginning students to laboratory rats.

Under the conditions imposed upon the subjects, the frequency of urination and defecation seemingly was unrelated to sex differences. It should be noted that the stress situation in this study was not an open-field test. Therefore, the findings should not be considered to support any position pertaining to sex differences in open-field tests.

The lack of relationship found between the urinary response and the defecatory response in the described stress situation raises doubt whether these two responses may be considered as equal or even as similar indicators of emotionality in the albino rat. The stress situation in the present study may be considered relatively weak since only 29 per cent and 50 per cent of the

N defecated and urinated during handling and testing. Possibly, higher relationships between frequency of urination and defecation exist under stronger stress conditions.

The nonsignificant relationship found between cooperative-uncooperative response to handling and defecation-nondefecation suggests that response to handling and frequency of defecation during observation were mutually independent. However, the urinary response during testing was significantly related to uncooperative response during handling. Uncooperative response and urination in a mild stress situation seemingly possess some commonalty.

E. Summary

Cooperative-uncooperative response to handling was investigated in the albino rat to determine whether sex membership was related to this dichotomized response. The relationships between response to handling and two indicators of rat emotionality, urination and defecation in a strange new situation, were also investigated. The results indicated that females ($N = 61$) showed more uncooperative response to handling than did males ($N = 52$). Uncooperative response to handling was significantly related to urinary response. Response to handling was not related to the defecatory response. Frequency of defecation during testing was not related to frequency of urination under the same stress conditions.

References

1. Bindra, D., & Thompson, W. R. An evaluation of defecation and urination as measures of fearfulness. *J. Comp. & Physiol. Psychol.*, 1953, **46**, 43-45.
2. Broadhurst, P. L. Determinants of emotionality in the rat. *Brit. J. Psychol.*, 1957, **48**, 1-12.
3. Farris, E. J., & Yeakel, E. H. Emotional behavior of gray Norway and Wistar albino rats. *J. Comp. Psychol.*, 1945, **38**, 109-118.
4. Hall, C. S. Emotional behavior in the rat. I. Defecation and urination as measures of individual differences in emotionality. *J. Comp. Psychol.*, 1934, **18**, 385-403.
5. Homme, L. E., & Klaus, D. J. Laboratory Studies in the Analysis of Behavior. Pittsburgh: Lever Press, 1957.
6. Hunt, H. F., & Otis, L. S. Conditioned and unconditioned emotional defecation in the rat. *J. Comp. & Physiol. Psychol.*, 1953, **46**, 378-382.
7. O'Kelly, L. I. The validity of defecation as a measure of emotionality in the rat. *J. Gen. Psychol.*, 1940, **23**, 75-87.
8. Parker, M. M. The interrelationship of six different situations in the measurement of emotionality in the adult albino rat. *Psychol. Bull.*, 1939, **36**, 564-565.
9. Singh, S. D. Conditioned emotional response in the rat; I. Constitutional and situational determinants. *J. Comp. & Physiol. Psychol.*, 1959, **52**, 574-578.
10. Stone, C. P. Wildness and savageness in rats of different strains. *In* Lashley, K. S. (*Ed.*), *Studies in the Dynamics of Behavior.* Chicago: Univ. Chicago Press, 1932.

11. THOMPSON, W. R. Exploratory behavior as a function of hunger in "bright" and "dull" rats. *J. Comp. & Physiol. Psychol.*, 1953, **46**, 323-326.

12. THOMPSON, W. R., & BINDRA, D. Motivational and emotional characteristics of "bright" and "dull" rats. *Canad. J. Psychol.*, 1952, **6**, 116-122.

13. TRYON, R. C. Individual differences. *In* Moss, F. A. (*Ed.*), *Comparative Psychology*. New York: Prentice-Hall, 1942.

14. YANG, KUO-SHU. A study of habit regression in the albino rat. *Acta Psychol. Taiwan.*, 1960, **2**, 79-89.

15. YERKES, R. M. The heredity of savageness and wildness in rats. *J. Anim. Behav.*, 1913, **3**, 286-296.

Department of Psychology
University of North Dakota
Grand Forks, North Dakota

The Journal of Genetic Psychology, 1963, **102**, 75-81.

EXPRESSED WISHES OF STUDENTS*

Faculty of Education, University of Western Australia

D. K. Wheeler

A. Introduction

The expressed wishes of adolescents still in school in Western Australia have been discussed elsewhere (5). In order to attempt cross-cultural comparisons and consider developmental trends, we completely reanalyzed the data using Jersild's categories (1) as well as the reduced number derived from them by Wilson (2). These categories are indicated in Table 1. It will be noticed that, in some cases, Wilson subsumes a number of Jersild's categories under his more general ones.

TABLE 1
Categories Used by Jersild and Wilson

Categories: Jersild		Categories: Wilson
I	Specific material objects and posessions	1. Possessions and activities
III	Good living quarters	
IV	Activities, sports, diversions	
II	Money	2. Money
VI	Vocation	3. Vocation
V	Opportunities and accomplishments	4. Physical and Psychological Benefits for Self
VII	Be bright, smart	
VIII	Moral self-improvement	
IX	Improved personal appearance	
X	Personal prestige, adventure	
XI	Supernatural power	
XVI	Relief from irritations, etc.	
XVIII	General inclusive benefits for self	
XIX	General immunities for self	
XII	Have baby, sibling	5. Social Relationships
XIV	Parents never die	
XV	Companionship	
XIII	To be married, have a lover	6. Marriage
XVII	Specific benefits for parents and relatives	7. Altruistic
XX	General benefits for relatives	
XXI	General benefits for others, philanthropies, etc.	

* Received in the Editorial Office on February 27, 1961.

B. Results and Discussion

Our results from this analysis are shown in Table 2 which also includes Wilson's results for Cornell College men (3) and Hunter College women (2). In the Western Australian sample, all age and sex groups were compared. The 13-year-old girls (Year 1) differed significantly from the 15-year-old (Year 3) and 17-year-old (Year 5) girls at the .01 level. The 15-year-old girls differed from the 17-year-old girls at the .05 level. All differences between the 13-year-old, 15-year-old, and 17-year-old boys were significant at the .01 level.

With age, the girls' wishes were more often concerned with opportunities and accomplishments, vocations, marriage, and general benefits for the self. Wishes for specific material objects and possessions grew progressively less. This was also true for the boys. In addition, the older boys were less concerned with good living quarters and general benefits for relatives, but made more general philanthropic wishes.

Sex differences were highly significant for each age group. Boys wished more often than girls for specific objects, money, marriage, good living quarters, and general benefits for the self, while girls wished more often for activities, sports and diversions, and general benefits for relatives. At the youngest age, more girls than boys made philanthropic wishes, but this difference had disappeared by the age of 17.

When these data were combined into the seven categories indicated by the Arabic numerals in Table 2 the same significant differences were found. All boys' comparisons and those for girls 1–3 and girls 1–5 were significant at the .01 level or better. As they grow older, adolescents make fewer wishes for possessions and activities and more wishes concerned with money, marriage, physical and psychological benefits for the self, and vocations. Boys seem more concerned with money, girls with altruistic wishes, and social relationships.

Tests of significance were made on Wilson's data for 129 college women (2) and 50 college men (3). There were sex differences significant at the .001 level, both for the complete range of categories and the reduced sevenfold classification. The men's wishes referred to money, vocations, and marriage; the women's wishes referred to possessions and activities, social relationships, and philanthropies. These differences between males and females are similar to the differences found between boys and girls in our Western Australian sample. We conclude that there are sex differences in the sorts of wishes individuals make in reply to the question, "If you had three wishes, what would you wish for?"

TABLE 2
PERCENTAGE OF MALE AND FEMALE WISHES FALLING INTO CATEGORIES SUGGESTED BY JERSILD (ROMAN NUMERALS) AND WILSON (ARABIC NUMERALS)

Categories	Western Australian high school boys			U.S. college men	Western Australian high school girls			U.S. college women
	Year 1	Year 3	Year 5		Year 1	Year 3	Year 5	
I	23	14	7	—	18	9	4	2
III	7	4	1	—	2	1	—	2
IV	6	8	7	1	15	13	10	11
1. Total	37	26	14	1	34	23	14	15
2. II	9	6	7	20	4	3	3	15
3. VI	7	12	14	27	7	10	13	17
V	4	7	9	1	5	8	11	5
VII	2	2	3	1	1	2	3	3
VIII	1	—	2	1	3	5	4	2
IX	1	1	2	—	2	3	—	—
X	—	1	2	6	—	2	1	2
XI	—	—	—	—	—	—	—	—
XVI	—	—	—	—	1	1	—	—
XVIII	13	13	14	15	5	9	13	11
XIX	1	2	1	—	—	—	1	1
4. Total	22	27	33	23	18	29	34	23
XII	1	1	—	—	1	1	4	2
XIV	1	—	—	—	1	1	—	—
XV	2	2	2	3	4	3	3	5
5. Total	4	3	2	3	6	5	7	7
6. XIII	4	8	11	23	3	6	8	9
XVII	4	3	2	1	6	4	3	7
XX	4	2	2	—	6	4	5	5
XXI	9	12	14	3	16	15	12	8
7. Total	17	17	18	3	27	24	20	14
Total wishes	418	407	314	150	411	437	215	387
Total subjects	152	142	115	50	148	152	75	129

For convenience percentages have been rounded to the nearest whole number.

In view of these sex differences, we must be cautious of any data concerning wishes where results from males and females are not considered separately. One explanation of the difference between Wilson's two groups of elderly people (3) may lie in the different sex ratios of the two groups. The "charity" group had 31 men and 24 women; the "paying" group had 15 men and 33 women. A further difference may be due to the fact that only the first wishes of the "charity" group were reported, while all three wishes of the "paying" group were given. The fact that both sexes have been con-

sidered together also reduces the value of the results for 11- and 12-year-old children, for five- and six-year-old children, and for the Grade 1 children's birthday wishes reported by Wilson (4).

This is disappointing, because Wilson was obviously interested in developmental trends. He suggested the presence of trends from children through elderly people and college women to college men. These trends were towards decreasing interest in possessions and activities, social relationships, and altruistic affairs, and towards increasing interest in money, vocations, and marriage. In our Western Australian sample, we noted the decreasing interest in possessions and activities and the increasing interests in money and marriage.

We must, however, confine our comparisons to Wilson's college men and women, as results for all other groups were not reported separately by sex. Despite this fact, it is fairly obvious that developmental trends are present. Until we are certain what these trends are in general and over what period they extend, we should be cautious of data which cover a wide age spread. In consequence, even the results for college men and women become limited in their usefulness because the men were aged seventeen to 25 and the majority of the women were between 20 and 30.

Wilson himself suggests that a further factor which may produce differences between groups is socioeconomic status. This seems very likely and possibly accounts for some of the differences between Wilson's two elderly groups and between his two youngest groups of first grade children.

We found it impossible, therefore, to fulfill our aim, which was to make cross-cultural comparisons. We can, however, suggest that over the period from childhood to early maturity wishes relating to possessions and activities decrease, while wishes relating to vocations and marriage increase. There are also other developmental trends which merit investigation. For instance, more work must be done in this country, as well as in the United States, to determine what causes the difference between our seventeen-year-old boys and Wilson's college men, and between our oldest girls and Wilson's college women in the proportion of wishes concerned with money. Are these differences due to cultural factors, to developmental factors, or to both? We have found significant sex differences with respect to wishes about money, vocations, marriage, social relationships, and, possibly, those in the altruistic category. Tentatively, we also suggest that socioeconomic status may account for differences in wishes. On this hypothesis, it might be expected that Wilson's elderly "charity group" would wish more often for specific possessions and/or money than the elderly "paying" group. Similarly, the five- and six-year-olds

should wish more often for specific possessions than the first grade children making birthday wishes, because the birthday wishes were made by children of superior socioeconomic status. Inspection of Wilson's tables shows that both groups do these things.

The sex differences which we have noted merit further consideration. Both in the United States and in Western Australia, males made more wishes concerned with money, vocations, and marriage; female wishes were more concerned with social relationships, and benefits to parents, relatives, and others. It can be suggested that these sex differences are a function of concepts of the male and female sex roles. Certain aspects of the male role are clearly defined in both countries. Men are expected to work to earn money to marry and establish a family. Implicit in the popular culture carriers (and indeed in all those socializing influences to which the growing child is exposed) are the ideas that it is the men who do the seeking and asking in courtship, and that women have to wait to be asked. Expectations with respect to the female role in modern technological societies are not so clearly defined and images both of the "homemaker" and the "career girl" are possible. The comparative lack of clarity of definition of the female role may explain why it is that both Western Australian high school girls and New York college women wish less often to be married than do their male counterparts. Or it may be that marriage does not seem so attractive to career-minded young women. There is more possibility of role conflict and the "career girl" may feel that she has more to lose in marriage than the man. A further point must be raised. As girls do have to wait to be asked in marriage, many adolescent girls, resenting this, go through a sort of "feminist" phase of not being interested in or not wanting marriage. We noted this elsewhere in our survey and found that 17-year-old girls showed less interest in boys than did 15-year-old girls. It must be remembered, however, that this significant sex difference could arise from sampling factors. While our sample was representative in its three levels of adolescents still as school, it was a biased sample of the adolescent population at large. Wilson's college women (and men) were obviously accidental samples.

It has been suggested by Wilson (2) that people wish for things which experiences have made them believe are both valuable and attainable. We suggest that children entering school see material possessions as valuable as ends in themselves. Consequently, at this level, a high proportion of wishes will be for specific objects or activities. While some of these wishes to have something, to do something, or to go somewhere, will be ephemeral and dependent on whims of the moment, there will be a solid core of wished-for

possessions influenced to some extent by what the culture indicates as suitable for boys or for girls. That is, the nature of the objects wished for will be culturally determined by the nature of the sex role. Only in this way can we account for the difference between the number of boys and girls wishing for specific objects and for the nature of the objects wished for. At least one third of the specific possessions boys wish for are cars, motorcycles, and rifles, which could not be used even if the wishes came true. As children grow older, things may still be valued for themselves, but some, at least for the boys, become symbols of adolescent striving towards maturity or of successful accomplishment (even if only in fantasy) of the adolescent task of working out a masculine social role. Perhaps, in effect, the adolescent boy is saying "If I had a gun, or a car, or a wife and children, or were successfully established in a job, then I should be further on with this business of growing up and showing myself to be a man, as my society defines a man." Further cross-cultural investigation would be of value in this area.

In commenting on another sex difference which was statistically significant, we are forced to rely on subjective judgments. Though girls made more altruistic wishes than boys did (and this was also true of Wilson's college women and men) we do not necessarily conclude that girls (or young women) are more altruistic than boys (or young men). There is considerable difference between statement and action. Our impression throughout the whole survey was that the girls were more sincere in answering questions concerned with values and attitudes and were certainly more verbal, in that they produced more material in response to open-ended questions. On the whole the boys' answers were more superficial and more reserved. In consequence, it may be that boys behave as altruistically as girls, but do not admit it on paper.

C. Summary

1. The expressed wishes of 800 adolescents still at school in Western Australia were analysed, using both Jersild's and Wilson's classifications.

2. Significant differences were found between the wishes made by boys and girls in this representative sample of high school students. Similar differences were found for United States college men and women.

3. Significant differences were also found between the kinds of wishes made by 13-year-olds, 15-year-olds and 17-year-olds of both sexes.

4. Tentative explanations of the differences are offered based mainly on the differential clarity of definition of the sex role.

5. It is suggested that factors affecting sorts of wishes expressed are sex, age, and socioeconomic status.

6. Wilson's data for college men and women were compared with those for the 17-year-old Western Australian students. Significant differences were found, but it was not possible to determine whether these were due to developmental or to cultural factors.

7. In view of the differences found it is suggested that investigators in this field need to pay close attention to sampling.

References

1. JERSILD, A. T., MARKEY, F. V. & JERSILD, C. L. Children's fears, dreams, wishes, daydreams, likes, dislikes, pleasant and unpleasant memories. *Child Develop. Monog.*, 1932, **12**.
2. WILSON, F. T. Expressed wishes of children and college women students. *J. of Psychol.*, 1938, **5**, 19-105.
3. ———. Expressed wishes of elderly persons, college men and birthday wishes of first grade children. *J. Genet. Psychol.*, 1939, **55**, 81-101.
4. ———. Birthday wishes of first grade children. *J. Genet. Psychol.*, 1939, **55**, 319-352.
5. WHEELER, D. K. Expressed Wishes of Adolescents Still at School. Paper prepared for Pan-Indian Ocean Science Congress, Karachi, 1960.

Faculty of Education
University of Western Australia
Nedlands, Western Australia

The Journal of Genetic Psychology, 1963, **102**, 83-89.

A CONSTITUTIONAL CORRELATE OF EARLY INTELLECTIVE FUNCTIONING*[1]

Fels Research Institute

Jerome Kagan and Stanley M. Garn

A. Introduction

The child's intellective functioning, as measured by standard intelligence tests, is influenced by a variety of factors. It has been shown that the child's IQ is associated with the educational level of his family (1, 7) and that maternal encouragement of cognitive development facilitates preschool IQ scores (8). Moreover, increases in IQ during the early school years are associated with competitive and independent behavior in a free play situation (10). Thus, it is reasonable to conclude that level of intellectual functioning is influenced by habits and motives learned during the first decade of life.

Other investigators have demonstrated that monozygotic twins are more similar in IQ than dizygotes, and that the correlation between the IQ of parent and child is moderately high ($r = .50$ to $.60$) (3, 4, 9). These data imply that genetically controlled mechanisms influence intellectual abilities.

One major obstacle blocking a detailed account of the biological bases of intelligence is our present inability to specify biological variables that might be associated with mental functioning in the non-diseased individual. This paper presents some evidence that tentatively suggests a relationship between a constitutional attribute and early intellectual ability.

In a recent investigation, Garn, Clark, Landkof, and Newell (5) have demonstrated that children born of parents who were both large chested (LL) were advanced in height, weight, and skeletal development in comparison to offspring of parents who were both small chested (SS). The bony chest diameter, as measured on radiographs, was selected as a measure of body mass because it is minimally related to adult stature ($r = .20$) and an excellent indicator of the fat free or lean body mass ($r = .90$) (2). Figure 1 presents the growth curves for height and weight for 32 boys and 32 girls of LL and SS parents.

* Received in the Editorial Office on February 27, 1961.

[1] This research was supported, in part, by research grants M-1260 and A-3816 from the National Institute of Health, United States Public Health Service.

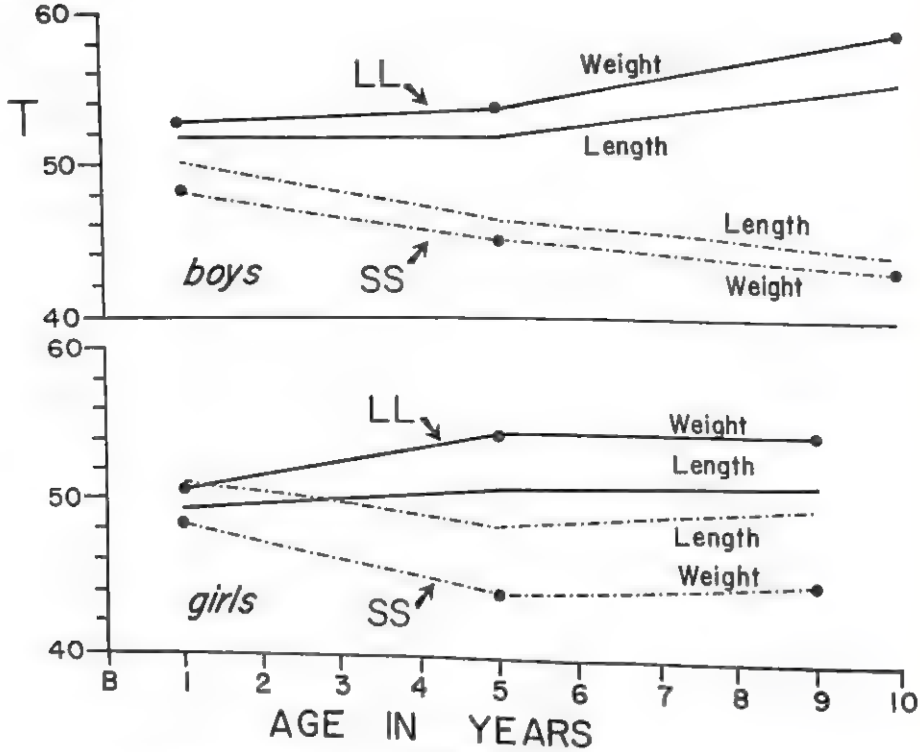

FIGURE 1
HEIGHT AND WEIGHT VALUES (IN NORMALIZED T-SCORES) FOR BOYS AND GIRLS BORN OF LARGE (LL) OR SMALL (SS) CHESTED PARENTS

The generally greater height and weight values (in normalized T-scores) for the children of large chested parents indicate that parental chest diameter is predictive of accelerated physical development in the child. The present research attempted to explore the relationship between parental and child chest diameter and the child's intellectual ability.

B. STUDY I

1. *Method*

Parental bony chest diameters, as measured on postero-anterior teleoroentgenograms, were obtained for 119 pairs of parents who were part of the Fels Research Institute's longitudinal population. The diameter at the tenth rib was the score used in all analyses. The distribution of chest diameters for each sex was divided at the median into large and small chested groups. Children born to parents who were both large chested (LL) were compared

with children of parents who were both small chested (SS) on mental test performance from 6 months to 10 years of age.

A maximum group of 88 children (46 boys and 42 girls) from LL or SS mating combinations had mental test scores on the Gesell Developmental Schedule (6) at 6, 12, and 18 months; the Merrill-Palmer Scale (11) at 24 months; and the revised Stanford-Binet (12) at 3, 3.5, 4, 5, 6, and 10 years of age. The IQ scores were computed for the Gesell and Merrill-Palmer Scales by applying the common formula MA/CA $\times$ 100 to the mental age equivalents obtained from these tests.

2. *Results*

There were no significant sex differences in average IQ within the LL or SS groups and the sexes were pooled in determining the differences between the children born of large versus small chested parents. Figure 2 shows the IQ scores for the children of LL and SS mating pairs.

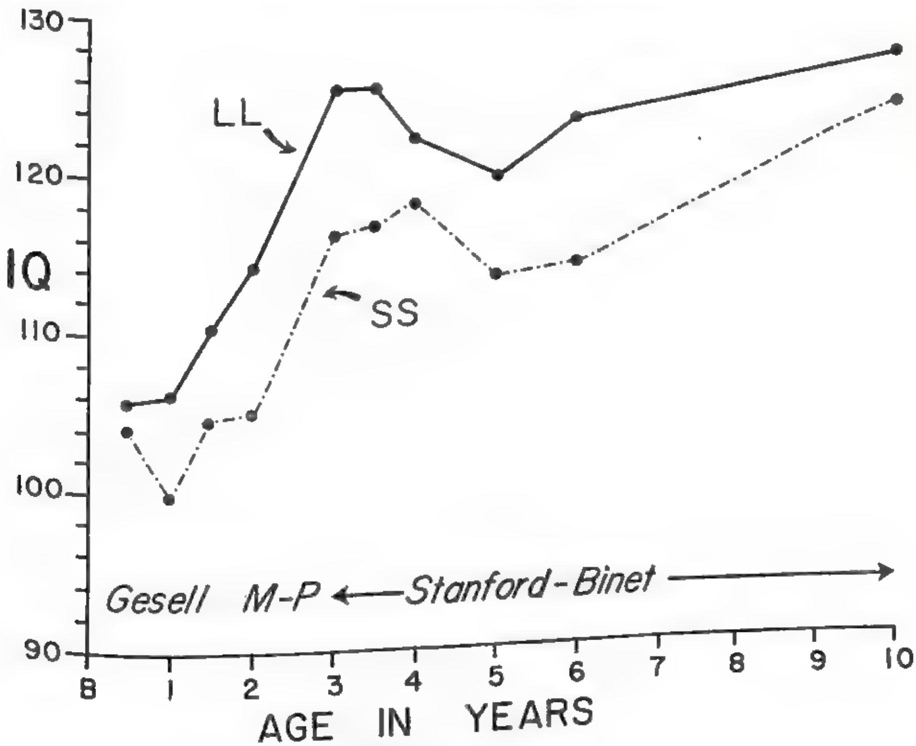

FIGURE 2
IQ Scores of Children Born of LL or SS Parents

The children of large chested parents had significantly higher IQ scores at 2, 3, and 3.5 years of age ($p < .02$, .05, and .05 respectively; two tails). The standard deviations of the IQ scores at these three age levels were similar for both LL and SS children and averaged 9 points for the Merrill-Palmer and 16 points for the Stanford-Binet. The differences in mean IQ between LL and SS children decreased with age and by age 10 were negligible. Thus, children born to large chested parents were advanced in early mental development. The product moment correlations between each parent's chest diameter and his adult Otis IQ were close to zero indicating no relation between the parent's chest size and his adult level of intellective functioning.

C. Study II

1. *Method*

In order to determine if the child's own bony chest diameter was predictive of his mental development, a maximum group of 72 boys and 69 girls with measurable chest radiographs at two years of age were selected for study. The distribution of chest diameters for each sex was divided into quartiles and the mean IQ on the Merrill-Palmer and Stanford-Binet scales were computed for each of the quartiles.

2. *Results*

Table 1 presents the mean IQ scores for each quartile on the Merrill-Palmer at age two and the Stanford-Binet at 3, 3.5, 4, 5, 6, and 10 years of age.

TABLE 1
MEAN IQ AND CHILD'S CHEST DIAMETER AT AGE TWO
CHEST DIAMETER QUARTILE

Age		*1* (Small)	*2*	*3*	*4* (Large)
2	Boy	111.4	109.5	118.1	118.1
	Girl	109.1	112.8	109.1	109.9
3	Boy	123.0	113.4	119.5	129.5
	Girl	127.8	119.1	124.2	124.5
3.5	Boy	118.4	114.1	111.1	131.7
	Girl	126.7	122.3	122.2	127.7
4	Boy	118.5	119.3	117.9	127.4
	Girl	124.9	119.4	121.4	121.4
5	Boy	116.1	114.3	117.1	127.3
	Girl	116.3	115.6	119.5	119.4
6	Boy	113.2	111.0	114.0	128.4
	Girl	122.4	117.7	120.1	120.3
10	Boy	127.5	115.6	124.6	136.3
	Girl	129.4	127.8	134.1	124.8

The girls' IQ scores were unrelated to their chest diameters. However, the boys with the largest chest diameters (Quartile 4) consistently had the highest IQ scores from three to 10 years of age. When the top and bottom quartiles were compared, significant differences were found at 3.5, 4, 5, and 6 years of age ($p < .05$; two tails). At age 3, the 16 point difference between the second and fourth quartiles was significant ($t = 3.26$, $p < .01$; two tails). The correlation (product moment) between the child's chest breadth at age two and his IQ at age three was .23 for boys ($p < .05$; two tails) and .05 for girls.

D. Discussion

Bony chest breadth, which is a sensitive index of fat free body weight, is associated in boys, with precocious mental development during the preschool years. The maximum effect occurs between three and four years of age.

It is not easy to explain these results. Because large chested children are more advanced in size and skeletal development, one might expect them to excel on perceptual motor items. The Stanford-Binet questions at age three are of this character (e.g., stringing beads, block building, copying a circle). However, the Stanford-Binet items at 3.5 years are primarily measures of language development (e.g., obeying commands, picture vocabulary, identifying objects by function, and verbal comprehension). Large chested boys are advanced over small chested boys on both language and perceptual motor skills during these early years. The fact that this association is stronger for boys than for girls is congruent with the physical growth curves (Figure 1). These data reveal that the differences in body size between children born of LL or SS matings are slightly greater for boys than for girls. The critical biological processes (associated with bony chest breadth) that facilitate both accelerated physical growth and early mental development seem to exert their effect more clearly on boys than on girls.

It is not unreasonable to postulate that fat free body mass and bony chest diameter are under genetic control. One challenging problem is to describe the intermediate mechanisms that account for the link between the biological characteristics and psychological phenomena.

Supplementary behavioral data on these children tentatively suggest that large chested children are less fearful in a test situation and more apt to persist in problem situations than the smaller children. Since early IQ scores are influenced by the child's fearfulness, the present results may be due to a relation between the child's size and his behavioral predispositions in

problem solving situations. Further research at the Institute is directed at this question and at discovery of other behavioral correlates of fat free mass.

E. Summary

This paper summarizes an exploratory investigation of the relationship between parental and child body build and the young child's intellective ability.

In the first study, parents were divided into above or below the median on bony chest diameter. The IQ scores of children born of two large chested parents (LL) were compared with those of children from small chested parents (SS). The LL children had significantly higher IQs at 2, 3, and 3.5 years of age. From ages four to ten the differences were negligible.

In a second study, the child's own bony chest diameter at age two was used as the predictor. Boys with large chests performed significantly better than small chested boys from three to six years of age, with the greatest differences occurring at 3 and 3.5 years. There was no relationship between chest diameter and IQ score for the girls. The superior performance of the large chested boys held both for perceptual motor and language development items.

It was suggested that bony chest diameter, which is an excellent index of fat free body mass, is associated with a less fearful approach to problem situations.

References

1. Bayley, N. Some increasing parent-child similarities during the growth of children. *J. Educ. Psychol.*, 1954, **45**, 1-21.
2. Behnke, A. R. The estimation of lean body weight from skeletal measurements. *Hum. Biol.*, 1959, **31**, 295-315.
3. Burks, B. S. The relative influence of nature and nurture upon mental and motor development. A comparative study of foster parent-foster child resemblance and true parent-true child resemblance. *Yearb. Nat. Soc. Study Educ.*, 1928, **27**, (I), 219-316.
4. Conrad, H. S., & Jones, H. E. A second study of familial resemblances in intelligence: Environmental and genetic implications of parent-child and sibling correlations in the total sample. *Yearb. Nat. Soc. Study Educ.*, 1940, **39**, (II), 97-141.
5. Garn, S. M., Clark, A., Landkof, L., & Newell, L. Parental body build and developmental progress of the offspring. *Science*, 1960, **132**, 1555-1556.
6. Gesell, A. The Mental Growth of the Preschool Child. New York: Macmillan, 1925.
7. Kagan, J., & Moss, H. A. Parental correlates of child's IQ and height: A cross-validation of the Berkeley Growth Study results. *Child Develpm.*, 1959, **30**, 325-332.
8. Moss, H. A., & Kagan, J. Maternal influences on early IQ scores. *Psychol. Rep.*, 1958, **4**, 655-661.

9. NEWMAN, H. H., FREEMAN, R. N., & HOLZINGER, K. J. Twins: A Study of Heredity and Environment. Chicago: Univ. Chicago Press, 1937.

10. SONTAG, L. W., BAKER, C. T., & NELSON, V. L. Mental growth and personality development: A longitudinal study. *Monogr. Soc. Res. Child Develpm.*, 1958, **23**, No. 2 (Serial No. 68).

11. STUTSMAN, R. Mental Measurement of Preschool Children. New York: World Book, 1931.

12. TERMAN, L. M., & MERRILL, M. A. Measuring Intelligence. New York: Houghton Mifflin, 1937.

Department of Psychology
The Fels Research Institute
Yellow Springs, Ohio

The Journal of Genetic Psychology, 1963, **102**, 91-94.

THE BEHAVIOR OF NORMAL AND STOMACH LESION SUSCEPTIBLE RATS IN SEVERAL LEARNING SITUATIONS* [1]

Washington University, School of Medicine

Jacob O. Sines, Charles Cleeland, and James Adkins

A. Introduction and Problem

A number of behavioral and physiological differences have been found between Sprague-Dawley albinos and a selectively bred substrain of stomach lesion susceptible rats (1, 2). Briefly, the stomach lesion susceptible animals have been found to be smaller in body weight at a given age, more active in an open-field test situation, to defecate more in the open field, to lose a smaller percentage of pre-deprivation weight as a result of 24 hours of water deprivation, to be less "dominant" in a test situation where two water deprived animals must compete for access to water and finally, to show greater intestinal motility under the condition of immobilization stress.

Some of the above findings would support the notion that the lesion susceptible animals might also differ from normal Sprague-Dawley rats with regard to their rates of acquisition of learned responses.

The present report deals with the data obtained when stomach lesion susceptible animals (SUS) and normal Sprague-Dawleys were observed in three different learning studies.

B. Method and Procedure

1. *Subjects*

Ten male SUS animals of the 6th selectively bred generation and 13 male Sprague-Dawley rats were studied. All animals had been born and raised in the same laboratory and had experienced the normal laboratory regime up to the time of the first study. All animals were between 75 and 80 days old when the first study began.

a. Study I. All animals were weighed and deprived of water for 24 hours and weighed for the second time. From this point on animals were given access to water for one hour per day. Animals in each group were

* Received in the Editorial Office on March 6, 1961.

[1] This research was supported in part by grant A-2765 M.H. from the National Institutes of Health, United States Public Health Service.

allowed to roam freely in groups of five for five minutes in a straight alley at one end of which water was available. This adaptation procedure was continued for four days after which single animals were allowed five minutes in the straight alley for three more days. The alley was four feet long with a one foot starting box separated from the runway by a manually operated guillotine door. The alley and start box were 7-1/4 inches deep and five inches wide, had hardware cloth top and bottom and were painted a medium flat gray.

Each animal was given one trial per day thereafter and the time required to reach the water after the start box door was opened was recorded.

b. Study II. The same groups of *S*s, again under 23 hours of water deprivation, were adapted to a *Y* maze. The maze was 5-1/2 inches wide and 8-1/2 inches deep and painted flat gray. The start box was eight inches long, the runway was 25-1/2 inches and the arms were 24 inches long. Water reward was employed and was always available beyond the black door while the white door was always blocked. The position of the doors was systematically varied and the correction method was used. *S*s were trained in blocks of five trials and the criterion of learning was nine correct responses out of 10 consecutive trials. If the *S* touched the incorrect door he was considered to have made an error on that trial. The time required for each animal to traverse the maze on the first training trial was recorded. At the termination of this study all *S*s were returned to *ad lib* food and water.

c. Study III. Two weeks after Study II was completed the same groups of animals started training in a modified Miller-Mowrer box. The box was 34 inches long, 8 1/2 inches wide, and 20 inches deep. The front was a sheet of clear plastic. The floor consisted of two grids, the bars separated by 3/4 inch. There was a 60 watt bulb under each of the grids. The grid shock employed was .67 ma. The bulb under one side of the grid was turned on for 10 seconds with the grid shock on that side overlapping the last four seconds of light. Both light and shock terminated contiguously. A manually started timer controlled the light and shock periods. *S*s were given three trials per day and the side of the box into which they were introduced was alternated. The criterion of learning was avoidance of the shock on all three of a given day's trials.

C. Results

a. Study I. The SUS animals lost an average of 9.03 per cent of their pre-deprivation body weight while the mean weight loss among the control animals was 7.44 per cent. The difference of 1.61 per cent is significant beyond the .02 level.

The average running times in seconds for the two groups for the one daily trial for each of three days were as follows: SUS animals, 33.17 ± 33.03, 25.54 ± 20.19, and 18.62 ± 11.90; the control animals, 18.36 ± 26.75, 11.82 ± 11.23, and 12.00 ± 13.38. Due to the highly skewed distributions of running times the Mann-Whitney U test was employed. The values obtained were: Day 1, $U = 35$, $p = < .05$; Day 2, $U = 34.5$, $p = < .05$; Day 3, $U = 40$, $p = < .10$. These data indicate that the SUS animals require more time to traverse the straight alley than normal Sprague-Dawley rats.

b. Study II. There was no difference in the average number of days the two groups required to reach criterion in the Y maze. The SUS group learned the discrimination in 11.69 ± 4.15 days, the control group in 12.20 ± 3.79 days.

On the first trial in the Y maze the SUS animals again took longer to reach the water. The average running times for the two groups were: SUS, 25.8 ± 13.2 seconds, controls, 16.8 ± 19.8 seconds. In view of the non-normality of these distributions the Mann-Whitney U was again used. The obtained $U = 18.0$, significant beyond the .01 level.

c. Study III. The SUS animals reached the criterion of avoidance learning significantly faster than the control animals. The respective means were SUS, 8.92 ± 3.62 days; controls, 14.67 ± 5.57 days. The difference of 5.75 yielded a t of 3.16, significant beyond the .01 level.

D. Discussion

The observation that stomach lesion susceptible animals traverse a straight alley and a Y maze more slowly than control *S*s is consistent with the previously reported tendency for the SUS animals to be more active in an open field test (1). The greater activity in the open field can be viewed as the greater behavioral response to environmental stimuli or, in another sense, the greater distractibility of these animals. Likewise, in the straight alley and the Y maze the SUS animals engaged in more exploration and retracing than the controls, thus required greater time to reach the reward.

While this greater running time might be considered to be a function of the lower drive state among the SUS animals (less weight loss following water deprivation) the fact that the SUS animals did not require a greater number of training trials to learn the black-white discrimination fails to support such an interpretation.

In the case of the avoidance learning the fact that the SUS animals learned more rapidly might also be a function of their greater motor activity observed in the open field. Thus, the SUS animals' generally higher level

of motor activity may have facilitated their acquisition of a learned response which involved gross motor movement.

Such findings, therefore, suggest that stomach lesion susceptible animals will be superior in one specific class of learning situations, those involving gross motor reactions, and inferior to Sprague-Dawley animals in others where the response to be learned is the inhibition or reduction of ongoing motor activity. Such studies are presently being planned.

E. Summary

The behavior of a group of 10 stomach lesion susceptible rats was compared with that of a group of 13 normal Sprague-Dawley albinos in: (*a*) a straight alley for water reward; (*b*) a *Y* maze requiring a black-white discrimination for water reward; and (*c*) a modified Miller-Mowrer box where grid shock avoidance was to be learned. The SUS animals were found to: (*a*) run the straight alley and *Y* maze more slowly than the controls; (*b*) to learn the *Y* maze discrimination as rapidly as controls; and (*c*) to learn to avoid grid shock more quickly than controls. The implication of these data for further study of differential learning rates was mentioned.

References

1. Sines, J. O. Behavioural correlates of genetically enhanced susceptibility to stomach lesion development. *J. Psychosom. Res.*, 1961, **5**, 120-126.
2. Sines, J. O., & Eagleton, G. Dominant behavior and weight loss following water deprivation in normal rats and rats susceptible to stomach lesions. *Psychol. Rep.*, 1961, **9**, 3-6.

Department of Psychiatry
University of Missouri
School of Medicine
Columbia, Missouri

The Journal of Genetic Psychology, 1963, **102**, 95-107.

SPATIAL REPRESENTATION IN DRAWING AS A CORRELATE OF DEVELOPMENT AND A BASIS FOR PICTURE PREFERENCE*

Department of Education, San Francisco State College

HILDA P. LEWIS

A. PROBLEM

This study is concerned with the development of spatial representation in children's drawings and with children's estimation of the relative merit of various methods of representing space in drawings.

Previous investigations (7, 8, 12) have analyzed development in drawing in terms of increasingly naturalistic representation. The assumption has been that children of about eight years of age and older try to draw objects as they appear to the eye whereas younger children ignore what they see and draw things as they know them to be.

The correctness of this view has been challenged by several authorities, including Sir Herbert Read (1), Henry Schaefer-Simmern (13), Rudolf Arnheim (1), and Viktor Lowenfeld (9), each of whom proposes an alternative explanation defended both logically and empirically. However, empirical evidence marshalled in support of non-naturalistic interpretations of development have been provided largely by case studies. Experimental verification of such interpretations involving many subjects performing under controlled conditions has not been attempted by previous investigators.

This investigation tests hypotheses based on Arnheim's theory (1) of the nature of developmental progress in drawing. Arnheim calls attention to the distinction between the physical act of seeing and visual perception. Seeing involves the projection of images upon the retina. Normally any given object is seen at a particular angle for an extremely brief period of time and as the eye moves, or as the object moves, or both, many varying projections of the object are cast upon the retina. Out of an enormous amount of visual data certain salient features are perceived. These perceptions form the basis for visual concepts of objects and it is to these visual concepts rather than to a single retinal image that the child refers in representing through graphic means objects in the environment. The child strives to

* Received in the Editorial Office on March 8, 1961.

present the object as a whole, rather than to show a single projection of it. The problem which confronts him is that of showing volume or depth through a medium which is flat. Successive discovery of increasingly adequate methods of depicting three-dimensional spatial relationships within the limits of a two-dimensional medium constitutes progress.

This formulation implies that as children develop they are able to render ever-more-fully the structural characteristics of three-dimensional objects within the limits of a two-dimensional medium. This view makes it possible to predict a developmental sequence in the representation of the structural, or spatial, characteristics of simple objects and to compare the predicted sequence with observed methods of dealing with spatial characteristics employed by children at different levels of maturity.

If children are indeed striving for greater structural clarity might they not, in addition, be able to discriminate among drawings in which the spatial characteristics of depicted objects are revealed with varying degrees of clarity, recognizing the superiority of the explicit over the ambiguous?

1. *Hypotheses*

The following hypotheses were tested:

1. A relationship exists between grade-level of pupils and method employed to indicate spatial characteristics in drawings.
2. The relationship of grade-level to method employed in indicating spatial characteristics is independent of sex.
3. Differences exist in preferences among pictures in which spatial characteristics are revealed with varying degrees of clarity.
4. Picture preference is independent of sex.

B. Method

1. *Development of an Instrument*

An experimental task was designed which would require children to indicate three types of space through drawing: spherical space, cubic space, and spatial depth. Three stimulus-objects were selected to correspond with each of the three types of space. Spherical space was objectified by a green glass globe circled with a yellow band; cubic space by a four-sided, flat-roofed toy house; and spatial depth by a diorama of a landscape in which a row of trees was arranged parallel to the sides of the containing box and was flanked by two rows of fences, each row consisting of three parallel fences and oriented at 90 degrees to the opposite row of fences and at 45 degrees to the side of the box and to the row of trees.

Next, five different drawings were made of each one of the stimulus-objects. Each drawing presented a different solution to the given problem in spatial representation and was based upon solutions to similar problems reported in the literature. These solutions, gleaned from several different investigations (2, 5, 6, 7, 8), were organized into a developmental sequence based upon the theory outlined above. Thus, each set of drawings illustrates five successive developmental levels in the representation of spherical space, cubic space, or spatial depth.

Within each set of drawings each succeeding drawing indicates more fully the spatial characteristics of the object depicted than does the preceding drawing. See Figure 1. Thus, in the drawings of the green glass globe, the first drawing, S_I, is merely a circular outline. Spatial characteristics remain ambiguous since the drawing could also be taken to be a hoop, disk, or dome. Filling in the circular outline in the second drawing, S_{II}, eliminates the possibility that the picture is intended to be a hoop, but the contour of the surface remains indeterminate. In drawing S_{III}, a rounded contour is suggested by the application of foreshortening to the yellow band. In S_{IV}, modeling enhances the illusion of roundness. In S_V the entire surface of the sphere is made visible through the use of modeling and an elliptically-shaped band, thus revealing the spherical shape completely and unmistakably.

In the drawings of the toy house, cubic space is indicated in the first drawing, C_I, by a square. In the succeeding drawing, C_{II}, three sides of the cube are shown, all lying in the same plane. In C_{III} an attempt is made to clarify the spatial relations of the three sides by "bending back" two sides, thus forming obtuse angles, creating a need for presenting the upper surface, and establishing three planes. By dropping one of the sides in C_{IV} the parallelism of the cube is revealed. In the final drawing, C_V, perspective is attempted.

The five drawings of the diorama reveal various ways in which children deal with the problem of spatial depth. In the first drawing, D_I, no attempt at spatial organization has been made; objects are scattered over the paper without relation to one another or to the vantage point of the observer. In the succeeding drawing, D_{II}, objects are linearly arranged along the lower edge of the paper. In D_{III} a horizontal line serves as a base-line and suggests a plane perpendicular to the surface of the paper. Deeper space is implied in drawing D_{IV} by the use of several base-lines placed one above the other, creating several distinctly delimited planes, each in turn increasingly distant from the viewer. In drawing D_V separate planes have been integrated to create a single gradually-receding plane.

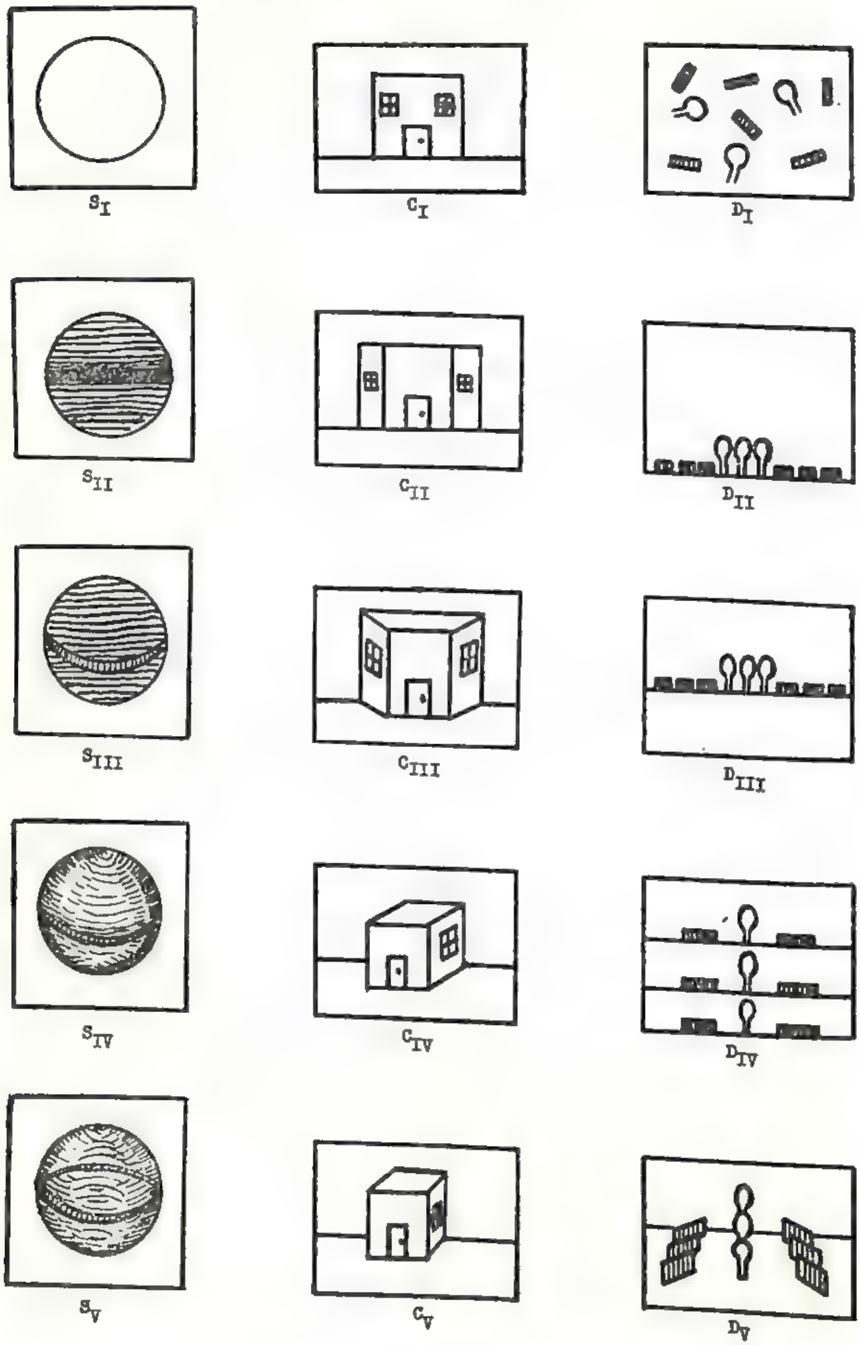

FIGURE 1
FIVE SUCCESSIVE LEVELS IN THE REPRESENTATION OF SPHERICAL SPACE, CUBIC SPACE, AND SPATIAL DEPTH

The three sets of drawings are predictive of the various solutions employed by children from Kindergarten through the eighth grade to the problem of indicating three-dimensional space relationships within the limits of a two-dimensional medium.

2. *Subjects*

The *S*s were 27 intact classes of children enrolled in grades Kindergarten through eight in five public schools in two neighboring San Francisco Bay Area communities. Three of the schools were elementary schools containing grades Kindergarten through six, and two of the schools were junior high schools containing grades seven, eight, and nine.

Of the elementary schools, one was situated in an upper-middle class neighborhood inhabited primarily by the families of professional people. The second elementary school was located in a middle-middle, lower-middle class neighborhood consisting primarily of skilled workers and including a large number of professionals, some unskilled workers, and a few businessmen. The third elementary school was located in a predominantly lower-middle class neighborhood with a large number of skilled or semi-skilled workers, and a small number of unskilled workers, professionals and University students.

One of the junior high schools drew from an attendance district which included lower-middle, middle-middle, and upper-middle class groups, the largest single occupational group composed of professionals and technicians. The second junior high school drew from an attendance district which extended into many different types of neighborhoods ranging from lower class to upper-middle class.

In each school there was a wide range of intelligence quotients. For the three elementary schools the range was 76 to 159, 79 to 151, and 66 to 174 respectively. For the junior high schools the range was 71 to 157 and 58 to 179 respectively. Median I.Q.'s in each of the five schools were 125, 112, 109, 107, and 108 respectively.

Educational achievement was above average in the elementary school located in the most favored district and about average in all other schools.

Pupils in one elementary school and in one junior high school were almost all from white American backgrounds. Many different ethnic and racial backgrounds were represented in the three remaining schools.

Classes within each school were selected at random. In each elementary school one class per grade participated in the investigation. One seventh- and

one eighth-grade class participated in the junior high school located in the more homogeneous attendance district. In the more heterogeneous junior high school, two seventh- and two eighth-grade classes participated.

A total of 2328 drawings were collected from 776 pupils. Preferences for pictures were expressed by 779 pupils.

3. *Procedure*

Children were shown and asked to draw the three objects described above. The following procedure was carried out in each classroom.

1. Three sheets of 8-1/2- by 11-inch drawing paper and a set of wax crayons were distributed to each member of the class.
2. The green glass globe was held up for the class to see. It was rotated; moved from side to side, up and down so that it could be viewed at various angles. Pupils were then asked to make a picture of it. Fifteen minutes were allowed to complete the picture. Next, the toy house was shown to the class and the procedure repeated. Finally the diorama was shown and the procedure repeated.
3. The three sets of drawings were consecutively displayed in a previously determined random order. Each child was asked to state which drawing of the five in each set "was best." Responses were made orally in individual interviews with children in grades Kindergarten through third. In the remaining grades, children responded in writing.
4. Each drawing was rated on the basis of the way in which spatial characteristics were indicated. In so doing, each pupil's drawing was compared with the appropriate set of five drawings developed by the investigator and assigned a rating of "1" through "5" to denote a correspondence between the pupil's and investigator's drawings with respect to the manner in which spatial characteristics were represented. For example, a picture of the diorama in which fences and trees were linearly arranged along a single base-line drawn parallel to the edge of the paper, as in D_{III}, was rated "3." A picture of the same object which employed several base-lines, one above the other, as in D_{IV}, was rated "4."

Ratings by the investigator were compared with ratings assigned by two independent investigators to 768 drawings representing complete sets of drawings from nine classes, one at each grade level. The percentage of agreement was found to be 91.4.

C. Results

Table 1 shows the distribution by grade of the methods employed in representing spherical space, as indicated by the rating assigned.

As can be seen in Table 1, drawings in which outlines were not reinforced by the use of color, rated "1," appeared more frequently in the Kindergarten than in other grades. Drawings in which the roundness of the object is not

TABLE 1
RATINGS BY GRADE OF THE REPRESENTATION OF SPHERICAL SPACE IN 776 DRAWINGS BY CHILDREN IN GRADES KINDERGARTEN THROUGH EIGHT

	Rating											
	1		2		3		4		5		Total	
Grade	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
K	27	36.00	46	61.33	2	2.67	0	0	0	0	75	100.00
I	8	10.00	56	70.00	16	20.00	0	0	0	0	80	100.00
II	3	3.37	62	69.66	23	25.84	1	1.12	0	0	89	99.99
III	5	5.68	57	64.77	26	29.55	0	0	0	0	88	100.00
IV	0	0	50	53.76	36	38.71	7	7.53	0	0	93	100.00
V	7	7.37	50	52.63	23	24.21	12	12.63	3	3.16	95	100.00
VI	8	9.52	26	30.95	25	29.76	19	22.62	6	7.14	84	99.99
VII	2	2.56	17	21.79	23	29.49	21	26.92	15	19.23	78	99.99
VIII	1	1.06	22	23.40	26	27.66	30	31.91	15	15.96	94	99.99

indicated, rated "2," occurred very frequently in the Kindergarten and primary grades and tended to decrease gradually from grades one through seven. The use of foreshortening to suggest roundness, in drawings rated "3," increased from grades Kindergarten through four then tended to decrease slightly and level off. Drawings which further clarified the spatial characteristics of the object depicted either by the addition of modeling or by the use of an elliptically shaped band, rated "4," were found in only one case below grade four and with gradually increasing frequency beyond grade four. No child below grade five employed both modeling and an elliptically shaped band for a rating of "5"; frequencies increased gradually from grades five to seven and decreased somewhat in grade eight.

The chi-square test was applied to data in Table 1. Chi-square was found to be 343.03 indicating a difference significant at the .001 level with 32 degrees of freedom.

Table 2 shows the distribution by grade of the methods employed in representing cubic space, as indicated by the rating assigned.

Table 2 reveals that almost all of the Kindergarten children depicted the toy house by a simple square, rated "1." This method of showing a cube-shaped object tended to decrease in succeeding grades. A few Kinder-

TABLE 2
RATINGS BY GRADE OF THE REPRESENTATION OF CUBIC SPACE IN 776 DRAWINGS BY CHILDREN IN GRADES KINDERGARTEN THROUGH EIGHT

	Rating											
	1		2		3		4		5		Total	
Grade	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
K	70	93.33	5	6.67	0	0	0	0	0	0	75	100.00
I	69	86.25	10	12.50	0	0	1	1.25	0	0	80	100.00
II	72	80.90	13	14.61	2	2.25	2	2.25	0	0	89	100.01
III	62	70.45	18	20.45	5	5.68	2	2.27	1	1.14	88	99.99
IV	33	35.48	29	31.18	18	19.35	13	13.98	0	0	93	99.99
V	27	28.42	21	22.11	22	23.16	22	23.16	3	3.16	95	100.01
VI	34	40.48	13	15.48	14	16.67	17	20.24	6	7.14	84	100.01
VII	10	12.82	3	3.85	13	16.67	33	42.31	19	24.36	78	100.01
VIII	11	11.70	4	4.25	11	11.70	45	47.87	23	24.47	94	99.99

garten children showed two or more sides of the toy house lying in a single plane, in drawings rated "2." This method was used with increasing frequency at each succeeding grade through grade four and then tended to occur with decreasing frequency. The "bending back" of one or more surfaces of the cubic object, in drawings rated "3," did not appear below grade two, appeared with increasing frequency through grade five, and with decreasing frequency thereafter. Drawings rated "4," which show the parallelism of the cube, did not appear in the Kindergarten, were rare in grades one, two, and three, and tended to appear with generally increasing frequency in succeeding grades. Only one perspective drawing was found below grade five, but such drawings occurred with increasing frequency above grade five.

A chi-square of 463.19 was obtained indicating a difference significant at the .001 level with thirty-two degrees of freedom.

Table 3 shows the distribution by grade of the methods employed in representing spatial depth, as indicated by the rating assigned.

As can be seen in Table 3, drawings devoid of spatial organization, rated "1," were common in the Kindergarten and decreased in each succeeding grade, disappearing entirely in grade six and above. A linear arrangement of objects along the lower edge of the paper, rated "2," was found more frequently in grade two than in other grades, rarely in grades four and five, and never in grades six, seven, and eight. A linear arrangement of objects along an elevated base-line, rated "3," occurred with increasing frequency from the Kindergarten through the second grade and tended to decrease thereafter. The use of multiple base-lines, rated "4," appeared with increasing frequency from the Kindergarten through grade three and then tended to

TABLE 3
RATINGS BY GRADE OF THE REPRESENTATION OF SPATIAL DEPTH IN 776 DRAWINGS BY CHILDREN IN GRADES KINDERGARTEN THROUGH EIGHT

	Rating											
	1		2		3		4		5		Total	
Grade	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
K	32	42.67	8	10.67	10	13.33	25	33.33	0	0	75	100.00
I	17	21.25	9	11.25	21	26.25	31	38.75	2	2.50	80	100.00
II	6	6.74	20	22.47	23	25.84	38	42.70	2	2.25	89	100.00
III	2	2.27	9	10.23	8	9.09	60	68.18	9	10.23	88	100.00
IV	1	1.07	1	1.07	12	12.90	57	61.29	22	23.66	93	99.99
V	1	1.05	2	2.10	4	4.21	58	61.05	30	31.58	95	99.99
VI	0	0	0	0	4	4.76	54	64.29	26	30.95	84	100.00
VII	0	0	0	0	0	0	52	66.67	26	33.33	78	100.00
VIII	0	0	0	0	1	1.06	60	63.82	33	35.11	94	99.99

level-off. The gradually receding plane, rated "5," did not appear at all in the Kindergarten, was rare in grades one and two, and tended to appear with slowly increasing frequency thereafter.

Chi-square was found to be 399.99 indicating a difference significant at the .001 level with 32 degrees of freedom.

A comparison was made of the ratings assigned to the drawings involving spherical space, cubic space, and spatial depth by 135 boys and 135 girls who were selected at random from each of the 27 classes on the basis of five boys and five girls per class. The Komolgorov-Smirnov two-sample test was applied to the distribution of ratings for boys and for girls on each drawing at each grade-level. No differences significant at the .01 level were found with respect to any one of the three types of spatial representation at any of the nine grade-levels.

Tables 4, 5, and 6 show which drawings of each set were considered best by children at each grade level.

The three tables reveal a tendency to prefer drawings of greater structural clarity, more pronounced in the higher grades than in the lower grades.

The Komolgorov-Smirnov one-sample test was applied to data in each table by grade-level. Preferences significant at the .01 level were not found in the Kindergarten for any one of the three types of spatial representation. Preferences significant at the .01 level were found in grades one through eight for each of the three types of spatial representation.

A comparison was made of the drawings involving spherical space, cubic space, and spatial depth considered best by 135 boys and 135 girls selected at random from each of the 27 classes on the basis of five boys and five girls per class. The Komolgorov-Smirnov two-sample test was applied to the

TABLE 4
DRAWINGS INDICATING SPHERICAL SPACE CONSIDERED BEST BY 779 CHILDREN IN GRADES KINDERGARTEN THROUGH EIGHT

	Drawing considered best											
	S_I		S_{II}		S_{III}		S_{IV}		S_V		Total	
Grade	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
K	3	3.85	30	38.46	9	11.54	19	24.36	17	21.79	78	100.00
I	0	0	15	19.74	6	7.89	37	48.68	18	23.68	76	99.99
II	0	0	9	10.23	8	9.09	50	56.82	21	23.86	88	100.00
III	0	0	4	4.35	2	2.17	43	46.74	43	46.74	92	100.00
IV	0	0	2	2.10	5	5.26	41	43.16	47	49.47	95	99.99
V	0	0	1	1.06	1	1.06	25	26.60	67	71.27	94	99.99
VI	0	0	0	0	2	2.30	33	37.93	52	59.77	87	100.00
VII	1	1.30	0	0	1	1.30	19	24.67	56	72.73	77	100.00
VIII	1	1.09	0	0	0	0	21	22.83	70	76.09	92	100.01

TABLE 5
DRAWINGS INDICATING CUBIC SPACE CONSIDERED BEST BY 779 CHILDREN IN GRADES KINDERGARTEN THROUGH EIGHT

	Drawing considered best											
	C_I		C_{II}		C_{III}		C_{IV}		C_V		Total	
Grade	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
K	10	12.82	24	30.77	17	21.79	11	14.10	16	20.51	78	99.99
I	5	6.58	10	13.16	18	23.68	30	39.47	13	17.10	76	99.99
II	2	2.27	3	3.41	24	27.27	32	36.36	27	30.68	88	99.99
III	4	4.35	3	3.26	25	27.17	30	32.61	30	32.61	92	100.00
IV	1	1.05	0	0	14	14.74	37	38.95	43	45.26	95	100.00
V	2	2.13	0	0	13	13.83	44	46.81	35	37.23	94	100.00
VI	2	2.30	0	0	13	14.94	43	49.42	29	33.33	87	99.99
VII	0	0	1	1.30	7	9.09	48	62.34	21	27.27	77	100.00
VIII	0	0	0	0	12	13.04	36	39.13	44	47.83	92	100.00

TABLE 6
DRAWINGS INDICATING SPATIAL DEPTH CONSIDERED BEST BY 779 CHILDREN IN GRADES KINDERGARTEN THROUGH EIGHT

	Drawing considered best											
	D_I		D_{II}		D_{III}		D_{IV}		D_V		Total	
Grade	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
K	19	24.36	11	14.10	10	12.82	16	20.51	22	28.20	78	99.99
I	4	5.26	5	6.58	10	13.16	10	13.16	47	61.84	76	100.00
II	13	14.77	3	3.41	9	10.23	7	7.95	56	63.64	88	100.01
III	3	3.26	1	1.09	11	11.96	10	10.87	67	72.83	92	100.01
IV	5	5.26	1	1.05	3	3.16	10	10.52	76	80.00	95	99.99
V	9	9.57	0	0	0	0	9	9.57	76	80.85	94	99.99
VI	4	4.60	1	1.15	0	0	5	5.75	77	88.51	87	100.01
VII	2	2.60	0	0	4	5.19	8	10.39	63	81.82	77	100.00
VIII	3	3.26	0	0	6	6.52	5	5.43	78	84.78	92	99.99

distribution of choices by boys and by girls of each drawing at each grade level. No differences significant at the .01 level were found with respect to choices of any one of the three drawings at any one of the nine grade levels.

D. Conclusions

1. The results support the hypothesis that a relationship exists between grade-level of pupils and the method employed to indicate spatial characteristics in drawings.
2. The results support the hypothesis that differences exist in preferences among pictures in which spatial characteristics are revealed with varying degrees of clarity.
3. No sex differences were found with respect to method employed to indicate spatial characteristics.
4. No sex differences were found with respect to preferences among pictures in which spatial characteristics are revealed with varying degrees of clarity.

E. Implications and Suggestions for Future Research

The results of this investigation suggest the possibility of establishing objective criteria for assessing developmental changes in representational drawing based upon specific structural characteristics as an alternative to the commonly-employed but subjective and gross criterion of degree of naturalism in representation.

This investigation presents some slight evidence that developmental progress may for a time move away from as well as in the direction of increasing naturalism. In the drawings of the toy house, C_I, C_{IV}, and C_V are naturalistically correct in that they approximate possible retinal images of the house. C_{II} and C_{III} are naturalistically incorrect in that the house could not appear to the eye as it does in the drawing, several sides being visible simultaneously. Table 2 shows that the largest per cent of naturalistically correct drawings occurred in the Kindergarten and that the percentage decreases steadily at each grade level through grade four increasing steadily thereafter.

The generally increasing consistency with which the most unequivocal representation of spatial characteristics is preferred at successive grade levels suggests a relationship to development.

A comparison of the ratings of drawings with the drawings considered best in each grade suggests that the child, in general, tends to consider best drawings which depict spatial characteristics more clearly than he himself is able to do.

Research is needed in which the above observations are formulated to function as hypotheses.

F. Summary

Previous investigations have analyzed developmental progress in drawing in terms of increasingly naturalistic representation. The present investigation adopts the definition of developmental progress in drawing as rendering ever-more-fully the structural characteristics of three-dimensional objects within the limits of a two-dimensional medium. This definition was employed in organizing into a developmental sequence observations of previous investigators of the methods children use to show spherical space, cubic space, and spatial depth. Drawings involving each of the three types of spatial relations were obtained from children in grades Kindergarten through eight and rated by comparison with the developmental sequence. Children were asked to express preferences for drawings which constituted the developmental sequence. A relationship was found between grade-level of pupils and the method employed to indicate spatial characteristics in drawings. Children tended to prefer pictures in which spatial characteristics were revealed with greater clarity. No sex differences were found.

References

1. Arnheim, R. Art and Visual Perception. Berkeley & Los Angeles: Univ. California Press, 1954. Pp. 408.
2. Barnhart, E. N. Developmental stages in compositional construction in children's drawings. *J. Exp. Ed.*, 1942, **11**, 156-184.
3. French, J. E. Children's preferences for abstract design of varied structural organization. *Elem. Sch. J.*, 1956, **56**, 202-209.
4. ———. Children's Preferences for Pictures of Varied Complexity of Pictorial Pattern. Berkeley: Unpublished Doctoral Dissertation, 1952. Pp. 131.
5. Hildreth, G. The Child Mind in Evolution. New York: Kings Crown Press, 1941. Pp. 163.
6. Kellogg, R. What Children Scribble and Why. San Francisco: 570 Union St., 1955. Pp. 137.
7. Kerschensteiner, G. Die Entwickelung der Zeichnerischen Begabung. Munich: Gerber, 1905. Pp. 508.
8. Lark-Horovitz, B., et al. Graphic Work Sample Diagnosis. Cleveland: The Cleveland Museum of Art, 1939. Pp. 67.
9. Lowenfeld, V. The Nature of Creative Activity. New York: Harcourt, Brace and Co., 1939. Pp. 272.
10. Munro, T., et al. Children's art abilities: studies at the Cleveland Museum of Art. *J. Exp. Ed.*, 1942, **11**, 97-155.
11. Read, H. Education Through Art. London: Faber & Faber, 1945. Pp. 320.
12. Rouma, G. Le Langage Graphique de l'Enfant. Brussels: Misch & Tron, 1913. Pp. 281.

13. SCHAEFER-SIMMERN, H. The Unfolding of Artistic Activity. Berkeley & Los Angeles: Univ. California Press, 1948. Pp. 201.
14. SIEGEL, S. Non-parametric Statistics. New York: McGraw-Hill, 1956. Pp. 312.

San Francisco State College
San Francisco, California

The Journal of Genetic Psychology, 1963, **102**, 109-114.

HEAD BANGING IN EARLY CHILDHOOD: A SUGGESTED CAUSE*

The Pennsylvania State University

VLADIMIR DE LISSOVOY

A. INTRODUCTION

Head banging is characterized by repetitive movements marked by a definite rhythm and monotonous continuity. The head is struck rhythmically against the headboard, side of crib or other objects. This is not a tantrum type of behavior but is marked by an almost compulsive repetitiveness. The incidence of this behavior among normal non-hospitalized children has been estimated to be five to 15 per cent (7). A description of this behavior based upon observation of 33 head bangers appears in another publication (6).

A wide variety of theories regarding the etiology of head banging appear in the literature. Most of these are not supported by empirical data or are based upon a very small sample of children.

According to Ribble (20), gentle motion or rocking is beneficial to infants because it ameliorates the shock of transition from a liquid to air environment. It is through such rhythmic activity that the neonate overcomes the "innate sensitivity of fear of falling" and such kinaesthetic experience is important in establishing the affective tie between mother and child. In a follow-up of some of the babies in her study Ribble noted, "Many of those who did not get this form of mothering frequently substituted it themselves with head rolling, body rolling, or other hyperkinetic manifestations during periods of stress."

Langford (15) notes that rockers and head bangers satisfy some basic need for rhythm and the common denominator of all rhythmic activities seems to rest in the pleasure of movement and the release of tension. A similar conclusion is drawn by Lourie (17) after an examination of available studies and observations of 130 children:

> . . . It is suggested that rhythm and movement serve similar roles and complement each other in their association to further growth, express tension and pleasure, and achieve relaxation.

Theories regarding etiology of dramatic rhythmic movements can be

* Received in the Editorial Office on March 8, 1961.

classified under the following general headings: *autoerotism* (3, 12, 24), *aggression* (8, 9, 10, 11), *motor release* (4, 13, 14, 16, 18, 19), *parent-child relationships* (1, 8, 20), *intracranial irritations* (2, 8, 9, 10, 21).

Of the above references none was oriented to the testing of hypotheses. The psychoanalytic generalizations of Clark and Uniker (3) were based on analyses of two children. Fitz-Herbert (9, 10) observed six cases. Lourie (17) based his comments upon observations of 130 children but it is not possible to determine whether such observations were made in the clinic, at the home of the child or whether they were in any way controlled.

The purpose of this paper is to present one aspect of a larger study of head banging and to suggest a possible etiology.

B. The Study

Fifteen head bangers were matched with a control group of subjects who did not manifest any dramatic rhythmic activities. The following variables were controlled: age, sex, weight, race, type of birth (spontaneous, instrumental, or section), birth order, socio-economic status and family structure. The age range was from 10 to 42 months; there were 11 boys and four girls in each group.

Each of the head bangers was observed in the process of head banging with a careful record made of the tempo and severity of the action. All of these children were observed in their homes. An interview with the mothers disclosed that in every case some form of rhythmic activity, such as head or body rolling, was present prior to the first birthday.

The revised form of the Stanford-Binet Scale was administered to 24 children in the matched groups. After the initial testing on Form L, a retest on Form M followed in one to three weeks. The scores obtained were adjusted for age differences in IQ variability and were averaged. The mean score for head bangers was 109.2; for non head bangers the mean score was 113.8. (This difference is not statistically significant.) The Gesell Developmental Schedule was administered to the six younger children and no differences were noted between the head bangers and the matched group.

In checking the health histories of the children, it was found that, according to the reports of attending physicians, six head bangers were treated for otitis media within the first year of life (two of these cases had recurring attacks). Only one case of otitis was noted in the non head banging group.

The relationship between otitis media and head banging has been noted by Podolsky (21). He states, "Of three children who had had otitis media,

TABLE 1
OTITIS MEDIA IN THE FIRST YEAR OF LIFE, DIAGNOSED AND TREATED

	Yes	No	Total
Head bangers	6*	9	15
Non-head bangers	1	14	15

* Two cases recurring attacks.
$P < .05$ (Fisher Exact Probability Test -) (23).

two developed head banging of the purely aggressive type, and a third that of a mixed or ambivalent kind."

Since the physicians in this study indicated the date of treatment of otitis it was possible to relate age at treatment to mothers' estimates of the onset of head banging. This is shown in Table 2.

TABLE 2
AGE OF TREATMENT OF OTITIS IN RELATION TO THE AGE OF ONSET OF HEAD BANGING

Case no.	Age of treatment for otitis	Age of onset of head banging (months)
8	9 and 11 months*	10
9	11	12
14	8	?**
11	8	12
1	2 weeks and 22 months*	7
29	11 and 12 months*	6

* Recurring attacks.
** Mother did not recall.

It will be seen that in four cases otitis preceded the onset of head banging. The children who had recurring attacks of otitis were observed to be the most severe head bangers based on the tempo and the force of their blows. In the one case in which the mother could not recall the exact age of onset, she estimated that it was before the first birthday of the child. The subject in question was a head roller at three months and continued this action until head banging commenced.

C. DISCUSSION

It has been shown that the head bangers in this study had a statistically significantly higher rate of diagnosed otitis media than the matched group children. It will be noted that these were diagnosed and treated cases and not maternal impressions. It should also be borne in mind that a mild middle ear infection, painful though it may be, is often undetected in very young children. In such cases the pain would cause fretfulness and crying and the

relief or amelioration of the discomfort would largely depend upon maternal perception and sympathy.

The response repertory of the infant is a limited one. In the first three months of life physical activity is characterized by an undifferentiated pattern of behavior as noted in the mass movement of extremities, lack of control and generally undirected activity. Reaction to intruding stimuli, be it noise, hunger, pain or other discomforts, elicits random activity modified by the constitutional differences of children.

The earliest gross muscle rhythmic activity patterns noted in this investigation was head rolling. It is proposed that this activity was accidentally discovered and found to be rewarding. Its early discovery is clearly associated with the fact that control of the head is the first differentiation in the cephalo-caudal progression of development. Once the discovery was made, its repetition was insured because of its intrinsic rewarding experience or because it served to obtain mother's attention. Subsequent frustration encouraged the repetition of the satisfying act increasing its habit strength.

In terms of primary causal factors no reason can be suggested for otitis to be related to head banging insofar as physiological or neurological relationships is concerned. It is apparent that the pain generated by this infection could have served to increase the state of tension thus raising the level of excitability and reactivity. The differential constitutional structure of the children could have been a mediating factor in response to such a stimulus, thus, the higher activity level of the head bangers could have produced a correspondingly more acute reaction pattern.

Reactions to stress are often marked by compulsive repetitive behavior. Foot tapping and drumming of fingers are excellent examples of nervous discharges that are characterized by simplicity or primitiveness in comparison with the workings of the normal mature nervous system. Reinforcement of this tendency for repetition may come from regularly repeated stimulations or from the reward that is obtained when the repetitive movement decreases the intensity of the primary stimulus. In folk parlance one notes the expression, "to rock with pain," this illustrates the possible contention that the pain stimulus served to release from the inhibitive control of the cortex normally meaningless movements and the reward of the lowering of the threshold of pain served to foster repetitiveness. The stimulus of an earache could produce such a reaction.

There is another possible relation of head banging to otitis. An ancient practice in the primitive days of dentistry was said to include the "pepper in the eyes" cure for a toothache. Be this truth or legend, the principle behind

it is sound; the intensity of the primary source of pain is decreased with the introduction of a distracting pain stimulus. This conjecture suggests the possibility that head banging may actually be a form of pain relief. A child in pain may have hit his head in a shaking random movement and, finding that this contact relieved the exacerbating irritation caused by otitis, the movement was repeated for its rewarding experience. In such a situation the primary stimulus of pain served to establish the habit of head banging. The reward of pain relief or decrease in pain, served to strengthen the habit pattern of head banging. Through the mechanism of generalization, other negative stimuli were relieved by a return to the "rewarding" behavior of head banging.

D. Summary

Fifteen head bangers were matched with a control group of subjects who did not manifest any dramatic rhythmic activities. Eleven boys and four girls ranging in age from 10 to 42 months were in each group. Age, sex, weight, type of birth and other relevant variables were matched. A statistically significantly higher incidence of otitis media was found in the head banging group.

Etiology of head banging is examined in terms of possible stress reaction or as a form of distraction and pain relief.

References

1. Bender, L., & Yarnell, H. An observation nursery: a study of 250 children in the psychiatric division of Bellevue Hospital. *Amer. J. Psychiat.*, 1941, **97**, 1170.
2. Cameron, C. H. The Nervous Child. New York: Oxford Univ. Press, 1924.
3. Clark, L. P., & Uniker, T. E. An analytic study of stereotyped habit movements in children. *J. Nerv. Ment. Dis.*, 1927, **66**, 46-50.
4. Coleman, W. M. Psychological significance of the body rhythms. *J. Comp. Psychol.*, 1921, **1**, 213-225.
5. de Lissovoy, V. Head banging in early childhood; an exploratory study of an atypical behavior pattern. Unpublished thesis. Cornell, 1959.
6. ———. Head banging in early childhood. *Child Develpm.*, 1962, **33**, 43-56.
7. ———. Head banging in early childhood; a study of incidence. *J. Pediat.*, 1961, **58**, 803-805.
8. English, O. S., & Pearson, G. H. Common Neuroses of Children and Adults. New York: Norton, 1937.
9. Fitz-Herbert, J. The origin of head banging; a suggested explanation with an illustrated case history. *J. Ment. Sci.*, 1950, **96**, 793-795.
10. ———. Head banging and allied behavior; further observations. *J. Ment. Sci.*, 1952, **98**, 330-333.
11. Freud, A. Aggression in relation to emotional development: normal and pathological. The Psychoanalytic Study of the Child, Vols. III-IV. New York: International Univ. Press, 1949.

12. ———. Three contributions to the theory of sex. The Basic Writings of Sigmund Freud. New York: Modern Library, 1938.
13. GESELL, A. Infant and Child in the Culture of Today. New York: Harper, 1943.
14. GREENACRE, P. Infant reactions to restraint. *In* Kluckhohn, C., & Murray, H. A. (*Eds.*), *Personality in Nature, Society and Culture*. New York: Knopf, 1938.
15. LANGFORD, W. S. Psychopathological problems. *In* Holt, L. E., & McIntosh, R. (*Eds.*), *Holt's Diseases of Infancy and Childhood* (12th Ed.). New York: Appleton-Century, 1953.
16. LEVY, D. M., & PATRICK, H. T. Relation of infantile convulsions, head banging and breath holding to fainting and headaches in the parents. *Arch. Neurology Psychiat.*, 1928, **19**, 867-887.
17. LOURIE, R. S. The role of rhythmic patterns in childhood. *Amer. J. Psychiat.*, 1949, **105**, 653-660.
18. MAHLER, M. Ego psychology applied to behavior problems. *In* Lewis, N. D., & Pacella, B. L. (*Eds.*), *Modern Trends in Child Psychiatry*. New York: International Univ. Press, 1945.
19. MITTLEMAN, B. Psychodynamics of motility. *Int. J. Psycho-Anal.* 1958, **38**, 197-201.
20. MORSE, J. L. Clinical Pediatrics. New York: Saunders, 1926.
21. PODOLSKY, E. (*Ed.*) Encyclopedia of Abberations. New York: Philosophical Library, 1953.
22. RIBBLE, M. A. Infantile experience in relation to personality development. *In* Hunt, J. Mc.V. (*Ed.*), *Personality and Behavior Disorders, V*. New York: Ronald Press, 1944.
23. SIEGEL, S. Non-Parametric Statistics for the Behavioral Sciences. New York: McGraw-Hill, 1956.
24. SPITZ, R., & WOLF, K. M. Autoerotism: Some empirical findings and hypotheses on three of its manifestations in the first year of life. The Psychoanalytic Study of the Child, Vols. III-IV. New York: International Univ. Press, 1949.

College of Home Economics
Department of Child Development
& Family Relationships
Pennsylvania State University
University Park, Pennsylvania

The Journal of Genetic Psychology, 1963, **102**, 115-124.

THE INTERDEPENDENCE OF SIZE, NUMBER AND VALUE IN YOUNG CHILDREN'S ESTIMATES OF MAGNITUDE* [1]

University of Oxford and Harvard University

HENRI TAJFEL AND DAVID G. WINTER

A. INTRODUCTION AND PURPOSE

There is a good deal of experimental evidence that the value or the emotional relevance of a stimulus is related to an overestimation of its magnitude; but the understanding of the processes to which this phenomenon might be due has been lagging behind. In a previous paper (7) two hypotheses were put forward. First, it was assumed that in a series of stimuli where the estimated magnitudes and the values of the stimuli to the *S*s vary concomitantly, the differences in these magnitudes between the stimuli are accentuated. Overestimation was seen as a by-product of this accentuation of differences. A review of the literature provided strong support for this assumption, and some subsequent experiments (8, 9) confirmed its general validity.

The second assumption was concerned with situations where the differences between the stimuli in their value to the subject were not related to the physical magnitudes being judged. In such cases, it was assumed, overestimation would not occur unless in the class of stimuli possessing the attribute of value there was some implicit relationship between the magnitudes under judgment and the value of the stimuli. If this condition was fulfilled, an accentuation of differences between those stimuli which had value and those which did not would result again in a relative overestimation of the former.

The review of the literature led to the conclusion that most experiments on overestimation which yielded negative results were those in which a relationship between value and the magnitudes being judged was not conceivable. There was, however, one notable exception: an experiment reported by Lambert, Solomon and Watson (4) which was one of the best controlled in this field. They found that when children were given candy in exchange for tokens (white poker chips), there was an increase in the estimated size of the tokens as compared with estimates before the introduction of reward;

* Received in the Editorial Office on March 8, 1961.

[1] Our thanks are due to Dr. Richard L. Solomon from the Department of Social Relations, Harvard University, for his help in all the preliminary arrangements for the experiment; and to Dr. Judith A. Schoellkopf and her staff at the Harvard Pre-school without whose cooperation the study could not have been conducted.

an extinction procedure dissociating the tokens from candy resulted in a decrease of the estimated size of the tokens; a reinstatement of the association was followed again by an increase in the estimated size of the tokens.

In the situation of Lambert *et al.* the *size* of the tokens was in no way related to their value: all the tokens were identical. There was a one-to-one correspondence between the *number* of tokens and of pieces of candy received by the *S*s. The shifts occurred, however, in the estimates of size. This result is in direct contradiction to the assumption stated above.

Lambert *et al.* used as their *S*s children three to five years old. These children had experienced, just before they gave their size estimates, a situation in which the number of tokens was directly related to the number of pieces of candy they had received. In view of the age of the children it is probable that the number of tokens and its relationship to the number of pieces of candy were relevant variables in the subsequent estimates of size. Piaget (5) has produced evidence that at this age the concepts of number and of size have not yet become "operationally" distinct. For example, estimates of numbers of objects are not, for the child of about four, separable from the space that these objects occupy. If a one-to-one correspondence is established by placing a row of bottles and a row of glasses so that each bottle faces a glass, the child perceives the numerical equivalence. If then one of the rows is expanded or contracted in full view of the child by placing either the bottles or the glasses nearer to, or further apart from each other, the numerical equivalence disappears, and the child's estimates are affected by the global situation in which either the "density" or the length of a row seem to form the basis for statements about quantities. As Piaget puts it:

> . . . all these children are capable of making the one-to-one correspondence, but . . . as soon as the visual correspondence is destroyed, the quantitative equivalence and even the qualitative correspondence no longer exists for the child. It is as though for the child quantity depended . . . on the global appearance of the set, and in particular on the space occupied by it. Even Mul, for instance, who could count, thought that "there are more where it's bigger" (5, pp. 45-46).

And again:

> The only possible interpretation is . . . to assume a kind of lack of differentiation between the number and the space occupied" (5, p. 48).

Piaget concludes:

> All the preceding experiments have shown that at a first level (usually at about the age of 4½–5), the child evaluates discontinuous quantities as if they were continuous, *i.e.*, extended, quantities (5, p. 86).

There would be, no doubt, some difficulties in inferring from Piaget's evidence that at the age of about four children are as yet quite incapable of manipulating discontinuous quantities in an abstract manner. One such difficulty may be, for example, in the inadequacy of verbal instructions and questions for eliciting from the child the most effective use of numerical concepts which it may already have at its disposal. There is, however, a "weaker" generalization which seems well substantiated by Piaget's results: that the child's estimates of discontinuous quantities are affected by the context of continuous quantities (such as width, length, area, etc.) within which they are made. The complementary proposition here is, of course, that in situations where estimates of number and of continuous magnitudes have been closely linked, the former are also likely to affect the latter within the "global set."

This would account for the results reported by Lambert, Solomon and Watson. The general trend of evidence in the overestimation studies is, as mentioned earlier, that this phenomenon occurs only when there exists some covariation between the magnitudes being assessed by *S*s and the value to them of the stimuli. A relationship does exist in the Lambert *et al.* study: there is a perfect positive correlation between the number of tokens and the number of pieces of candy received. Because of the age of the *S*s, the subsequent size estimates are not independent of this relationship, and overestimation shown in these estimates can be conceived as reflecting the interdependence of size and number.

This interpretation of the Lambert *et al.* results was put to test in the present experiment. From the assumptions just stated a specific hypothesis followed: that if in the *S*s' past experience there was no simple covariation between the number of tokens and the amount of reward received for them, the estimates of the size of the tokens made after the reward has been received would show no increase.

B. Procedure

The experiment was conducted on two groups of *S*s: a control group for which the conditions of the Lambert *et al.* experiment were reproduced as exactly as possible; and an experimental group for which, apart from the fact that there was no simple and clear relationship between the number of tokens and the amount of candy, conditions were the same as in the control group.

1. *Subjects*

Eighteen children from the Harvard Pre-school took part in the experiment. They were assigned in equal numbers to the experimental and control groups.

The *S*s in the two groups were matched for age and sex. The age range in the experimental group was from four years eight months to three years five months (mean age: 4.28); in the control group from four years ten months to three years seven months (mean age: 4.23).

2. *Apparatus and Method*

The *S*s were, as in the Lambert *et al.* experiment, "individually introduced to a token reward situation" (4, p. 637). They turned nine times the crank of a token machine which then delivered a white poker chip. This poker chip they immediately inserted into a vending machine standing next to the token machine, and received for it M & M candy. Both machines were those used originally in the Lambert *et al.* study. Both groups were rewarded for five days at the rate of five trials (i.e. five tokens) per day. In the control group, each child received one M & M from the vending machine for each token inserted—a total of five M & M's per day. In the experimental group, the number of M & M's delivered by the machine at the insertion of a token was randomized, and ranged from one to five per token. The randomization was different for each child for each day, but within each of the days it included all the numbers from one to five—a total of 15 M & M's per day.

The extinction procedure was identical for both groups: on the sixth day the tokens were obtained, and no M & M's delivered by the vending machine at their insertion. The criterion for extinction was the same as in the Lambert *et al.* study: "three minutes during which (the children) did not turn the handle of the work machine" (4, p. 638). On the seventh day reward was reinstated: five trials in the one-to-one reward sequence for the control group, and in the random reward sequence for the experimental group.

Size estimates of the token were made by the *S*s: (*a*) prior to the first reward sequence; (*b*) on the fifth day, immediately after the reward sequence of that day; (*c*) on the sixth day, immediately after the criterion for extinction has been reached; and (*d*) on the seventh day, after the five reinstatement trials.

The apparatus used and described by Bruner and Rodrigues (2) was used for the size estimates:

> The front of the apparatus, 9 inches square, consisted of 5 by 5 inch ground glass on the center of which was projected the light patch. The light source consisted of 10-w. concentrated-arc point-source lamp (Western Union) whose light source of .4 mm. gave a sharp image of the . . . circular figure used. The latter was obtained by cutting an appropriately-shaped aperture in a copper screen, and mounting (the screen) . . . on a rack and pinion between the light source and the ground

> glass. The distance of the aperture screen from the light source (determining the size of the cast image) was controlled by a knob on the lower left of the front of the apparatus (2, p. 19).
>
> The subjects stood in front of the apparatus with the light patch at or slightly below eye level, and about 12 to 18 inches away. The token, pasted on a 5 inch square gray cardboard, was held by the experimenters so that it was parallel to the circular patch. About seven inches separated the centers of the two objects to be compared. The judgment problem was presented to the children of both groups as a game. Each child made his estimates alone. Two judgments starting from the open and two starting from the closed position of the iris were obtained from each child at each measurement session; these judgments were made in an order which was counter-balanced for direction of turning the control knob. The children were not informed of their success in approximating the actual size of the poker chip (4, p. 638).

A dial at the back of the apparatus, connected with the knob regulated by the *S*, gave direct readings of the size estimates. In terms of the units into which the dial was divided, the actual size of the token was 89.5.

C. Results

The mean size estimates for both groups before and after reward, after extinction, and after reinstatement of reward are presented in Table 1. Analysis of results is summarized in Table 2.

a. Comparison between the size estimates of both groups. There are no significant differences between the (almost identical) size estimates of both groups before the introduction of the reward sequence. As can be seen from Table 1, the initial mean estimates of both groups are very accurate. The estimates of the experimental group are smaller than those of the control group after the reward sequence; the difference between the groups, as assessed by means of the Mann-Whitney U test (6) is significant at almost five per cent level. The differences between the estimates of the groups after extinction and after reinstatement are very small and do not reach significance.

b. Shifts in the estimates of size within the groups. None of the shifts for the experimental group are significant. For the control group, the increase of size estimates from before to after reward, and the decrease from after reward to after extinction are both highly significant, as assessed by the Wilcoxon matched-pairs signed-ranks test (6). The increase in estimates from after extinction to after reinstatement, though in the expected direction, does not reach significance.

c. Comparison between the groups in shifts of size estimates. The difference between the shifts from before to after reward, and from reward to ex-

TABLE 1
MEAN SIZE ESTIMATES OF BOTH GROUPS IN THE VARIOUS STAGES OF THE EXPERIMENT

Group	Before reward	After reward	After extinction	After reinstatement
Control	89.4	90.8	88.3	89.4
Experimental	89.7	88.1	88.5	88.9

TABLE 2
SUMMARY OF ANALYSIS OF RESULTS

Mean differences between size estimates of both groups[1]	Before reward	After reward	After extinction	After reinstatement
	—.3	+2.7*	—.2	+.5

Mean shifts in size estimates[2]	From before to after reward	From reward to extinction	From extinction to reinstatement
Control group	+1.4***	—2.5****	+1.1
Experimental group	—1.6	+ .4	+ .4
Differences between shifts in size estimates[3]	+3.0****	—2.9**	+ .7

* p almost .05.
** $p < .05$.
*** $p < .025$.
**** $p = .01$.
[1] + expresses a larger size estimate for the control group;
— the converse;
[2] + expresses a shift towards a larger size estimate;
— the converse;
[3] + expresses a difference between shifts in size estimates in the direction of a larger increase for the control group;
— the converse.

tinction are both in the expected directions, and both reach significance by the Mann-Whitney test. The difference between the shifts from extinction to reinstatement is not significant.

In summary, the results validate the original findings of Lambert, Solomon and Watson (4), and also confirm the hypothesis that overestimation does not occur when the one-to-one correspondence between the number of tokens and the amount of reward received for them is not established in the *S*s' past experience.

D. DISCUSSION

Some aspects of the results and of the experimental situation need to be discussed in more detail.

In the first place, the results clearly support the findings of the original

experiment. The trend of the differences in the estimates of the comparable groups is identical in both studies, apart from a less marked tendency shown by the *S*s in the present experiment to overestimate after reinstatement. At the same time, it is patent that the effects reported by Lambert *et al.* are markedly larger than the present ones. Lambert *et al.* report a mean increase in estimates after the reward sequence corresponding to seven per cent of the actual size of the token; a decrease of eight per cent from estimates after reward to estimates after extinction; and again an increase of four per cent from extinction to reinstatement estimates. The corresponding figures in the present experiment are: an increase of 1.6 per cent after reward; a decrease of 3.0 per cent after extinction; and an increase of 1.4 per cent after reinstatement. The fact that size estimates were taken in the original experiment after 11 days of reward, while in the present one after five days only, does not account for the discrepancy, as Lambert & Lambert (3) reported in a subsequent paper results approximately as large as the original ones after five reinforced trials run in one day. It is much more likely that the smaller amount of overestimation found in the present experiment is due to differences in the apparatus used for size estimates. Lambert, Solomon and Watson (4) used the original Bruner and Goodman (1) apparatus, in which the shape of the light patch matched to the token "was not truly round, containing the familiar nine-elliptoid sides found in the Bausch & Lomb iris diaphragm" (1, p. 37). In the present experiment size estimates were made, as stated above, with the apparatus used by Bruner and Rodrigues (2), and the shape of the light patch was circular. Bruner and Rodrigues report that the amount of overestimation found by them was larger with the nine-chorded light shape than with the circular one. Thus, the present results for the control group are consistent with the general trend of results in this field.

The general argument summarized previously and leading to the prediction that the *S*s who did not experience the one-to-one correspondence between the number of tokens and the amount of reward would not overestimate the size of the tokens, stands in need of further specification. It will be remembered that it was based on two assumptions: (*a*) that when there is a covariation between the magnitudes being judged and the value of the stimuli to the *S*s, an accentuation of judged differences between the stimuli which have value and those which do not will result in the relative overestimation of the stimuli belonging to the first category; and (*b*) that, in view of the age of the *S*s, the relationship between the number of tokens and the amount of reward in the reward sequence affected the subsequent estimates of size. The

latter assumption has already been discussed in some detail. It may be worth adding that our *S*s were doubtlessly aware of the one-to-one correspondence. For example, one little girl remarked (and her statement was not untypical) that "since K. (another *S* in the control group) had received five pieces of candy, she must have therefore had five turns."

The first assumption can best be discussed in the context of the judging situation. In their matching task the *S*s were comparing the size of two objects: the poker chip and the circular light patch. It was argued previously that the size (or perhaps, in view of the age of the *S*s, one should say the "global quantity") of the counter was for the control group a "relevant" dimension. An increase along this dimension meant an increase in the number of M & M's received. The light patch had no such significance associated with it: it was, as an object, definitely distinct from the counter, with no special meaning accrued to its size. From the point of view, however, of size judgments, these two objects did "belong" together and formed a series, as the task was to compare them with respect to size. Thus, the two objects are simultaneously for the children different and comparable. The comparison forced on them is in terms of the attribute of size, the crucial attribute both for the amount of reward and for the task at hand. The differences between the two objects could presumably be specified by the children in terms of a number of attributes; but the only specification of differences which they are allowed to make in the matching situation is based on this dually relevant characteristic. It is not unreasonable to assume that in such a situation the children will tend to express the qualitative difference between the two objects by means of the only channel open to them, the estimates of size; and this independently of whether these estimates have anything to do with what Lambert and Lambert (3) refer to doubtfully as the "visceral prededications" of a "stronger" stimulus.

The situation is different for the experimental group. They are also comparing in size two objects qualitatively different, but size is not an attribute relevant to this qualitative difference. In these *S*s' past experience there was no discernible relationship between the number (and, by implication, the size) of the tokens and the number of candies they had received. There is no *a priori* reason why estimates of size should be a channel through which this qualitative difference is expressed. Thus, in spite of the fact that the number of M &M's received by this group is three times as large for the same number of counters as the number received by the control group, there is not even a hint of overestimation in their estimates of size of the tokens.

One further point for which there is no adequate evidence, but which seems sufficiently interesting to be raised for its suggestive value: the children were asked to manipulate the knob until the circular light patch and the counter were "the same," and then to stop. This was done four times in each measurement situation, twice from the open (largest) position of the light patch, twice from the closed (smallest) position. Three or four *S*s in the control group, among those who after having received the reward for five days tended to overestimate the size of the counter consistently and markedly, were asked, after they had provided the data for the four estimates, to do the matching once again. This matching went again in the direction of overestimation, the light patch at the point of "the same" being considerably larger than the counter. These *S*s were then asked: "And now tell me which of the two is bigger?" Invariably, they pointed correctly to the light patch. There is an important suggestion here that overestimation is not what might be called a "purely" perceptual phenomenon. It is as if perception operated here simultaneously at two levels, both behaviourally genuine but separable; as if the first spontaneous estimates expressed one form of categorization of experience not incompatible, but also not identical, with another form, closer to the sensory information received at the time of matching.

E. Summary

Two groups of children aged about four matched the size of counters before these counters had been associated with reward, after this association has been established, after it has been disrupted, and after it has been reinstated. For one group there was a one-to-one correspondence between the number of counters and the amount of reward received; for the other group, there was no clear relationship between the two. The first group overestimated the size of the counters after reward, and decreased its estimates of size after the extinction procedure. The results for the second group showed no consistent shifts in their estimates of size. The differences in performance between the two groups are discussed in terms of the hypothesis of accentuation of differences between magnitudes relevant to the amount of reward, and in terms of the interdependence for the children of the concepts of size and number.

References

1. Bruner, J. S., & Goodman, C. C. Value and need as organizing factors in perception, *J. Abnorm. & Soc. Psychol.*, 1947, **42**, 33-44.
2. Bruner, J. S., & Rodrigues, J. S. Some determinants of apparent size. *J. Abn. & Soc. Psychol.*, 1953, **48**, 17-24.

3. LAMBERT, W. W., & LAMBERT, E. C. Some indirect effects of reward on children's size estimations. *J. Abnorm. & Soc. Psychol.*, 1953, **48**, 507-510.

4. LAMBERT, W. W., SOLOMON, R. L., & WATSON, P. D. Reinforcement and extinction as factors in size estimation. *J. Exp. Psychol.*, 1949, **39**, 637-641.

5. PIAGET, J. The Child's Conception of Number. London: Routledge & Kegan Paul, 1952.

6. SIEGEL, S. Nonparametric Statistics for the Behavioral Sciences. New York: McGraw-Hill, 1956.

7. TAJFEL, H. Value and the perceptual judgment of magnitude. *Psychol. Rev.*, 1957, **64**, 192-204.

8. ———. The anchoring effects of value in a scale of judgments. *Brit. J. Psychol.*, 1959, **50**, 294-304.

9. TAJFEL, H., & CAWASJEE, S. D. Value and the accentuation of judged differences: A confirmation. *J. Abn. & Soc. Psychol.*, 1959, **59**, 436-439.

Department of Social & Administrative Studies
University of Oxford
Oxford, England

The Journal of Genetic Psychology, 1963, **102**, 125-137.

A METHOD FOR THE MEASUREMENT OF THE SELF-CONCEPT OF CHILDREN IN THE THIRD GRADE*

Institute for Psychosomatic and Psychiatric Research and Training of the Michael Reese Hospital and Medical Center, and The Menninger Foundation

Mary Engel[1] and Walter J. Raine[2]

A. Problem

Although the literature on the measurement of self-concept grows rapidly each year, there are few techniques to be found that are suitable for use with latency age children. It was the purpose of this study to assess the usefulness of a relatively simple instrument, the "Where Are You Game," in measuring the self-concept of children in the third grade.

B. Background

It is beyond the purpose of this presentation to discuss the many theoretical vantage points from which the self-concept is studied. Methodologically, the most recent studies of the self-concept rely on the Q-sort (1, 2, 3, 6, 7) or on the use of adjective check lists (5, 8) or on projective tests (2, 9) as the principal method of assessment. There is growing interest in exploring the developmental aspects of the self-concept (1, 3, 9), yet some of the commonly used methods are not well suited to such explorations in that they place considerable demands on the child. It may well be that reports of the self-concept of the child are unstable enough to change appreciably when demands threaten various aspects of ego integration. In addition, it is to be expected that scores derived from a simple method of assessing self-concept will be more reliable than scores derived from either projective tests or Q-sorts. The reason for this is that under the stress produced by a projective test or the Q-sort, differential behavior will occur in a group of children. Some children will regress more than others, show more dependent behavior, suffer memory lapses, etc. Since this is a *differential* effect with direct consequences upon the reported self-concept, a spurious spread will be observed in scores effected by it.

* Received in the Editorial Office on March 13, 1961.

[1] At the time of this study the writer was USPHS Post-Doctoral Clinical Research Fellow at the Menninger Foundation (MF-6502-C), presently at the Graduate School of Education, Harvard University.

[2] The writer was a member of the Coping Project at the Menninger Foundation (M-680) at the time of this study. He is now at the Neuropsychiatric Institute, Medical School, University of California, Los Angeles.

C. Method

With these considerations paramount, we devised a simple instrument called the "Where Are You Game." It is composed of seven bi-polar dimensions, each one thought to be important in the child's self-concept, on which the child was asked to rate himself on a five-point scale in the form of a vertical "ladder."

Following the ratings, an inquiry was conducted in which the child was asked to tell why he chose to rate himself as he did.

The seven dimensions were as follows:[3]

A. seeing oneself as intellectually gifted, versus seeing oneself as lacking in such capacities,

B. seeing oneself as happy, as opposed to considering oneself unhappy,

C. considering oneself well liked by peers, versus seeing oneself as unpopular,

D. seeing oneself as brave, as opposed to considering oneself easily frightened,

E. conceiving of oneself as physically attractive, or unattractive,

F. considering oneself strong, or weak physically,

G. seeing oneself as doing what one should, versus seeing oneself as being disobedient.

Each of these dimensions was allotted a page with five lined spaces, vertically arranged, representing the five-point rating scale. Next to the top and the bottom space there was an extra space for demonstration purposes.

Twenty-nine school children, attending the third grade in a parochial school (Protestant) were seen individually by the examiner. The group consisted of 16 boys and 13 girls, the mean age was 8.42 years, with standard deviation of 3.46 months.[4]

---

[3] The seven dimensions were chosen on an *a priori* basis as representing salient features of the concerns of latency age children. Since the completion of the present research, work by Kilpatrick and Cantril, published in November 1960, in the *Journal of Individual Psychology* has come to our attention. These authors are studying the social, economic and political problems of various nationalities by means of a ten point "ladder scale." While there the subjects set their own "worst" and "best" anchoring points; our method seems to be similarly adaptable to the measurement of variously chosen dimensions.

[4] This sample of third grade pupils may not be representative of children in the public schools. Religious and economic factors along with the parents' preference for a school with more than the usual amount of discipline may slant the findings in unknown directions. However, plans call for the repetition of the present study with children who are subjects in the Coping Project. Under the direction of Dr. Lois B. Murphy, the Coping Project at the Menninger Foundation has been engaged in

Each child was conducted into a quiet room and was told that the examiner would like to play a game with him. The child was seated next to the examiner and a box of crayons was presented along with the data blanks. Then the examiner said the following:

> Today I'd like for us to draw some pictures together. Here is a sheet of paper with some lines on it. Now I'm going to take one of these crayons and I'm going to draw a boy (or a girl depending on the child's own sex) and I'll tell you about him. (At this point the examiner drew a stick figure in the upper left line and as she drew she went on to talk to the child.) Here is a boy who is very happy. He's always smiling and laughing and full of fun. Now I'm going to draw you another boy down here. (The examiner now drew another stick figure in the lower left line of the page.) This boy is not very happy, in fact he's mostly sad and serious. He doesn't smile and laugh like the other one. (At this point the child was allowed to comment and make changes in the drawing or in any other way explore the situation he was presented with.)
>
> Now I'm going to tell you about the other lines in between. What I'd like for you to do is to take this pencil and make a mark on one of these five lines and what you have to decide is where are you between these two boys. If you put your check mark up here (examiner pointed to the "happy boy") that means that you think you are like him—happy and smiling and full of fun. If you put your mark by this boy down here, that means that you think you are like him—sad and serious. But you can put your mark anywhere in between depending on where *you* are. (Now in an informal way the examiner ascertained if the child had in fact understood the principle of the five-point rating scale. The child placed his check mark and he was allowed to make changes in his decision if he wanted to.)
>
> Now I would like for you to tell me how come you decided to put your check mark on the third line (or which ever one he chose). (The child's responses were then verbatim recorded.)

The above procedure was used for each of the seven dimensions, with appropriate changes in the wording. The children soon understood the principle of the five-point rating scale. All *S*'s rated themselves on the seven positive-negative scales. Only thirteen *S*'s were given the inquiry also, because of time limitations imposed by the school situation.

---

the longitudinal study of the patterns of coping with problems in 32 normal children. The use of the self-concept measurement technique reported here with Coping Project subjects should enable us not only to evaluate the effects of sampling bias in the present study, but should also provide for the correlation of the self-concept measure with a number of developmental variables.

D. Results and Discussion

Our investigation resulted in two kinds of data: self-ratings of positiveness on scales A, B, C, D, E, F and G, by 29 children and verbal responses to the inquiry following the ratings by 13 of the 29 children.

First, we tested the hypothesis that the positiveness ratings revealed individual differences, i.e. that the five-point ratings reflect more than random variation. The minimum positiveness rating any child could obtain was seven points, the maximum 35 points. Examining self-ratings on seven scales for each child made it possible to test the significance of the individual differences as well as the differences between scales in eliciting positiveness ratings.

Table 1 presents the data bearing on this hypothesis.

TABLE 1
Analysis of Variance Showing Individual Differences in Positiveness of Self-Ratings on Seven Scales for 29 Children

Sources of variance	Sum of squares	Degrees of freedom	Mean sum of sq	F	p
Between individuals	67.34	28	2.405	2.51	$<.01$
Between scales	6.85	6	1.142	1.19	n.s.
Residual	160.87	168	.958		
Total	235.06	202			

Whereas scales did not differ in the positiveness ratings they elicited, individual children differed from each other in the extent to which they saw themselves in a positive light.

However, the lack of significant variance between scales A, B, C, D, E, F and G does not necessarily mean that responses to them are uncorrelated. It seemed of interest to find out if significant factors could be isolated, if children rating themselves high (or low) on any of the scales would be likely to do so on one or more others.

Table 2 presents the intercorrelations among the scales. Table 3 shows the results of a Principal Components Factor Analysis after a "Quartimax" rotation.

Our interpretations of the emerging factors are, of course, provisional, subject to revision, if necessary, in the light of alternative explanations and further research.

Factor I is heavily loaded on two tests, Popular and Obedient. Evidently the self-concept of these children is intensely involved with relations to others, peers and adults respectively. It is interesting to observe that

TABLE 2
INTERCORRELATIONS OF CHILDREN'S SELF-RATINGS (5-POINT SCALES) ON SEVEN ATTRIBUTES
(N = 29)

	Smart Not smart A	Happy Unhappy B	Popular Lonesome C	Brave Afraid D	Nice looking Unattractive E	Strong Weak F	Obedient Disobedient G
A	—	.054	.219	—.203	.365	.073	.080
B	—	—	.119	.029	.271	—.261	—.004
C	—	—	—	.275	.104	.418*	.545**
D	—	—	—	—	.261	.522**	.409*
E	—	—	—	—	—	.287	.010
F	—	—	—	—	—	—	.371*
G	—	—	—	—	—	—	—

* Significant beyond .05 level.
** Significant beyond .01 level.

TABLE 3
QUARTIMAX ROTATED[a] PRINCIPLE COMPONENTS FACTOR ANALYSIS OF SELF-RATINGS ON SEVEN SELF-CONCEPT SCALES

		Factor					
Name	Var. #	I	II	III	IV	V	h^2
Smart	1	—.1346	.0203	.9380	.0539	—.0056	.9013
Happy	2	—.1400	—.1228	—.0203	.9565	—.0229	.9505
Popular	3	—.9259	.1199	.1908	.0644	—.1508	.9350
Brave	4	—.3354	.7435	—.4018	.1040	.0552	.8406
Attractive	5	.0313	.6343	.4551	.4674	.2633	.8982
Strong	6	—.1747	.8230	.0612	—.3461	—.2479	.8928
Obedient	7	—.9651	.1914	—.0204	—.0045	.0129	.9686
Available variance		.28	.24	.18	.18	.02	.9124

[a] Rotation and factor analysis performed on IBM 650 at Kansas University, Lawrence, Kansas.

The authors are grateful to Miss Lolafaye Coyne for operating the computer and debugging the programs for our use.

Popular is not associated with Attractive and Strong. The factor loadings in the rotated form shown here seem to violate the observation that Popular *is* associated with Strong in the correlation table. The association is not as strong as that of Obedient and Popular, but it is still of considerable magnitude. In any event, the popularly accepted view that latency age children are more docile than others might be explained by this aspect of the self-concept, i.e., the relationship between popularity and obedience.

Factor II is heavily loaded on Strong, Brave and Attractive. This factor appears to be a reflection of the peer culture primarily. It accounts for almost as much variance as Factor I. The emphasis seems to be on attributes of the self, mostly physical, rather than relational as in Factor I. If a larger sample had permitted an analysis in terms of sex, it may well have emerged that Attractive is a virtue to girls and Strong a virtue to boys.

Factor III is primarily loaded on Smart with secondary loadings on Brave and Attractive. This factor accounts for a considerably smaller amount of variance than either Factor I or Factor II. This would seem to indicate that of the variety of dimensions that are explored here few are to be found in association with Smart. It is something apart, something special in the child's self-concept.

Factor IV is primarily loaded on Happy with moderate loadings on Attractive and Strong. Again, the amount of variance is appreciably less than on Factors I and II. It is of interest to observe that Happy stands in the same kind of isolation as Smart. Apparently, seeing oneself as Popular or Attractive doesn't automatically lead to seeing oneself as Happy.

Factor V has only two moderate loadings, going in different directions, on Attractive and Strong. This may very well be a function of the mixed sample with boys loading on Strong and girls loading on Attractive. In any case, the amount of variance attributable to the factor is so small that it is not very important to this analysis.

In summary, the results seem to suggest that the self-concept of third grade pupils in this particular school is primarily organized in terms of interpersonal relationships and such attributes as Strong, Attractive and Brave. The variables Smart and Happy are far less intertwined in the table of correlations and together account for less than half as much variance as the factors Popular and Obedient.

Since the seven scales cannot be factored into only one or two factors but represent various combinations of no less than five significant factors, it seems appropriate to consider the seven scales as representing seven different components of the self-concept. If this assumption is made, it is possible to consider the sum of the seven ratings as a measure of a rather global self-concept. The consistency with which the seven scores reflect the global self-concept is reflected in the estimate of reliability. A modified Kuder-Richardson Formula 20 estimate results in a figure of .60, the only estimate of reliability that may be made in the absence of test-retest results. This estimate of reliability is derived from the correlation of the seven self-concept scores with the total score and was computed from an analysis of variance by using intra-class correlation after partialling out the difference between means on the seven self-concept scores (4).

It will be recalled that in addition to the ratings, we also obtained verbalizations from thirteen children given in response to the examiner's question: "How come you rated yourself as you did?" These verbalizations operationally define what we may label as the "sources" of the self-ratings. The verbalizations were detached from the ratings and sorted by one of the authors into the following categories:

1. *Admission of Inadequacy*

Acknowledgment of shortcomings, failure or imperfection of oneself as well as expression of dislike of situations faced. The possibility of failure may be recognized and if so, the response falls in this category. Dysphoric mood is not necessarily present, but may be. Generally, there is an indication that negative information about the self is admissible into awareness. ("I rate myself here because I am not pretty at all.")

2. *Frequency*

Children whose responses fall in this category express their ratings in terms of "sometimes," "at times," "I usually . . . ," etc.

3. *Concrete Experience*

Others may be drawn into the response, but the main feeling tone of the rating of self is one of personal involvement in a concrete experience, active participation from which the child derived his rating. ("I am strong because my brother and I weighed; and I weighed fifty pounds.")

4. *Reflected Appraisal*

The child's response is based on the evaluation or judgment of others. (Mother, father, teacher, other children, etc.) He may rely on the verbal judgment of others, or he may be using elements of others' behavior toward him as the source of his self-rating. (Good grades, expression of friendship by others may be used as a source of rating the self.) Statements of obedience or compliance when used to explain one's rating of oneself are included in this category. ("I am a good boy because I do as mother tells me.")

5. *Relativity*

Children using this category compare themselves with others and rate themselves on the basis of how they stack up in this comparison. ("Jimmy P. is popular, but I am not as popular as he is, so I'll rate myself here.")

6. *Miscellaneous*

For items on which judges cannot decide.

The five categories might be conceptualized as lying on a continuum reflecting "inner" to "outer" judgmental basis. Each of the statements comprising these categories denotes a reference system for the self-concept. Category 1, Admission of Inadequacy, refers almost exclusively to the child's reflections upon his own inner state. This is somewhat true of Category 2 but more weakly, with considerable dependence on external reality and the frequency with which self-feelings are experienced. Category 3, Concrete Experience, includes statements about the self that are based on a certain event or experience; i.e. a large component of outer reality is included. In using Category 4, Reflected Appraisal, the child is clearly more in the realm of outside reality than his inner world. Here he relies on the judgment of others. The use of Category 5 indicates almost complete reliance on

outside reality, in that to give a statement falling in this category, the child has to compare himself to others. In other words, Categories 4 and 5 cannot be used by the child without taking other individuals actively into consideration. Thus, the psychological continuum underlying the five categories seems to be one expressing the "inner-outer" orientation or internality-externality of the self-concept ratings.

It is of interest to note that in our group of subjects internality meant negative self-appraisal, i.e., no child used the internal frame of reference in a positive sense. Statements such as "I rate myself here because I know I am good" were conspicuously absent from the sample.

In order to test the reliability with which the statements made in the inquiry (referrents of the self-concept) were sorted into the six categories, all statements made by the thirteen children to the seven scales were mounted on three- by five-inch cards and four independent judges were asked to sort them into the above categories. The cards were devoid of any cue by which the child, or the scale to which he responded could be identified. However, before we could assign scale values to the statements, an operation necessary for correlating judgments, we wanted to reassure ourselves that there might be an underlying continuum. We reasoned that if this dimension in fact underlies the categories, then the frequency with which the responses were used would be approximately normally distributed. Table 4 shows that this prediction was borne out.

TABLE 4
DISTRIBUTION OF STATEMENTS REFLECTING THE SOURCES OF THE SELF-CONCEPT INTO CATEGORIES OF THE INNER-OUTER DIMENSION

Category	Predicted frequency (experimenters)	Observed frequency (4 judges)
1. Admission of inadequacy	Low	34
2. Frequency	Middle	65
3. Concrete experience	High	99
4. Reflected appraisal	Middle	86
5. Relativity	Low	52

Although the distribution is skewed in the direction of external judgment, the symmetrical pattern does appear in the observed frequencies. Having shown that the empirical distribution of these categories followed the form of distribution of other psychological continua, we felt we could assign scale values to the statements indicating the source of the self-concept. The assignment of scale values of one to five, going in the direction "from the inside out," allowed us to express the agreement between four judges in

correlational terms, and enabled us to test additional hypotheses concerning the relationship between positiveness of self-ratings and the source of the self-concept. Table 5 shows that while the agreement among judges is not high, it indicates sufficient reliability to warrant further work.

TABLE 5
AGREEMENT AMONG FOUR JUDGES IN SORTING STATEMENTS REFLECTING THE SOURCES OF THE SELF-CONCEPT GIVEN BY 13 CHILDREN TO SEVEN SELF-CONCEPT SCALES
(N varies from 77 to 81 depending on the number of statements in the miscellaneous category)

Judge	I	II	III	IV
I		.55**	.22*	.42**
II			.54*	.62**
III				.50**
IV				—

* Significant beyond .05 level.
** Significant beyond .01 level.

The question now arose whether children are significantly different from each other with respect to their scale position on the "inner-outer" continuum, i.e., if individual children tend to rely on characteristically different sources in making self-ratings. We were also concerned with the question whether the seven self-concept scales elicit self-ratings from significantly different sources.

To explore these questions, an analysis of variance was performed. Table 6 shows that individual differences regarding the source of self-ratings were indeed sharp, and that some of the scales tended to elicit significantly different responses along the "inner-outer" continuum. The significant interaction between children and placement of statements on the "inner-outer" continuum shows that individuals use different ends of the continuum for different scales.

Lastly, we hypothesized that the sources of self-ratings would be independ-

TABLE 6
ANALYSIS OF VARIANCE OF THE RATINGS ASSIGNED ON THE "INNER-OUTER" CONTINUUM TO STATEMENTS BY 13 CHILDREN IN RESPONSE TO SEVEN SELF-CONCEPT SCALES

Sources of variance	Sum of squares	Degrees of freedom	Mean square	F	p
Between individuals	57.96	12	4.83	6.44	$<.01$
Between scales	33.72	6	5.62	7.51	$<.01$
Individuals × scales	205.20	72	2.85	3.81	$<.01$
Within (error)[a]	183.75	245	.75		
Total	480.63	335			

[a] The error term is derived from an estimate of within cell variance based on four independently assigned ratings.

ent, on the whole, from the positiveness of self-ratings. Correlations were computed between self-ratings and the scale positions on the "inner-outer" continuum. Table 7 indicates that the hypothesis was too general. There was a significant relationship between scale G, seeing oneself as obedient,

TABLE 7
CORRELATIONS BETWEEN SELF-RATINGS AND THE SOURCE OF SELF-RATINGS ("INNER-OUTER" CONTINUUM) FOR SEVEN SELF-CONCEPT SCALES
($N = 13$)

Self-concept scales	r with source
A. Smart	.34
B. Happy	.29
C. Well liked	—.35
D. Brave	.13
E. Attractive	.30
F. Strong	—.06
G. Obedient	.70**

** Significant beyond .01 level.

and the source of self-rating, meaning that children who see themselves as very obedient tend to rely on the judgments of others as a source of the rating. The relationship between scale G and the "outer" frame of reference for self-ratings tends, to some extent, to support the validity of our technique. Obedience is an act requiring compliance with the wishes of others and could only be judged in terms of outside referent. The non-significant correlations between sources and the other self-concept scales shows that the consideration of the source adds to our understanding of the self-concept in that an aspect separate from the positiveness-negativeness aspect has been defined.

E. DISCUSSION

It is apparent that the "Where Are You Game" is a reasonably sensitive instrument which measures various aspects of the self-concept of this restricted sample of third grade pupils. It differentiated well between pupils and an over-all score for positiveness of self-concept had a reliability estimated to be .60. Although there were significant correlations between the seven variables tested, the factorial structure is quite complex with at least four and perhaps five separate factors involved after rotation.

With the reservation that this study is only preliminary and is expected to be repeated on another sample, the substantive findings are of some general interest.

The self-concept of these children is organized around two main factors accounting for more than 50 per cent of the variance. They are as follows:

Factor I—Quality of Interpersonal Relationships with both peers and adults. Factor II—Highly Valued Personal Attributes such as Bravery, Strength and Attractiveness. Equally interesting is that Happiness is not an important aspect of either of these two factors, but stands somewhat alone in the table of correlations. There is nothing in these data to indicate which of the seven dimensions is the most highly valued by children of this age but these results certainly suggest that if one sees oneself as Popular, one does not automatically see oneself as Happy, for example. The same remarks apply equally well to Smart. It is a dimension by itself and not related to the others.

The results of the inquiry and the categorization into the referents of the self-concept may be very important, but because of the very small sample size have to be considered as suggestive rather than definitive. In any case the data in this study would certainly indicate that an inquiry can add substantially to an understanding of the general data as well as to the individual response.

F. Summary

An examination of the self-concept of children in the third grade utilizing a simple instrument making minimal demands showed that children differ in the positiveness of their self-concept. The factors representing the intercorrelation of self-concept scores result in five factors with Quality of Interpersonal Relationship and Personal Attributes accounting for more than 50 per cent of the variance. The sources of the various ratings of self-concept may lie on a continuum of inner experience to comparisons with external reality and tend to be consistent for a given child, and are unrelated to the magnitudes of ratings.

References

1. Balester, R. The self-concept and juvenile delinquency. Unpublished Ph.D. dissertation, Vanderbilt Univ., 1955.
2. Edelson, M., & Jones, A. E. Operational exploration of the conceptual self-system and of the interaction between frames of reference. *Genet., Psychol. Monogr.*, 1954, **50**, 43-139.
3. Engel, M. The stability of the self-concept in adolescence. *J. Abnorm. & Soc. Psychol.*, 1959, **58**, 211-215.
4. Haggard, E. A. Intraclass Correlation and the Analysis of Variance. New York: The Dryden Press, Inc., 1958.
5. Helper, M. M. Learning theory and the self-concept. *J. Abnorm. & Soc. Psychol.*, 1955, **51**, 184-194.
6. Nunnally, J. C. An investigation of some propositions of self-conception. The case of Miss Sun. *J. Abnorm. & Soc. Psychol.*, 1955, **50**, 87-92.

7. ROGERS, C. R., & DYMOND, F. F. (*Eds.*), *Psychotherapy and Personality Change.* Chicago: Univ. Chicago Press, 1954.

8. SARBIN, T. R., & ROSENBERG, B. G. Contributions to role-taking theory: IV. A method for obtaining a qualitative estimate of the self. *J. Soc. Psychol.*, 1955, **42**, 71-81.

9. WALSH, A. M. Self-Concepts of Bright Boys With Learning Difficulties. New York: Bureau of Publications, Teachers College, Columbia Univ., 1956.

Graduate School of Education
Harvard University
Cambridge 38, Massachusetts

The Journal of Genetic Psychology, 1963, **102**, 139-144.

THE RELATION BETWEEN INTER-PARENT AGREEMENT AND SEVERAL CHILD MEASURES*[1]

San Jose State College

GENE R. MEDINNUS

A. INTRODUCTION AND PROBLEM

Although numerous discussions of role theory have included comments concerning the role conflicts produced by varying role demands and role prescriptions which an individual must satisfy, there is little research data to support this notion. With specific reference to the parent-child relationship, role theory would suggest a relation between the extent of parental agreement in various child-rearing attitudes and certain aspects of child behavior, such as evidence of role conflict, ability to adjust to several role expectations and demands, and general adjustment. A recent study which employed the Parent Attitude Survey developed by Shoben and teachers' ratings of children's adjustment presented data to support the conclusion that ". . . there is a greater discrepancy between the attitude scores of parents of poorly adjusted children than between parents of well adjusted children (1, p. 519)."

The writer has dealt elsewhere with the consistency of parental agreement from one measuring instrument to another (5). The point was made that concern should be shown not only with the relation between inter-parent agreement and child adjustment but also with the consistency of parental agreement. Three instruments which assessed parent attitudes and parental perception of child were employed. Little consistency in inter-parent agreement among the three measures was found.

The present paper details the analysis of data pertaining to the relation between inter-parent agreement on several attitudinal measures and teacher ratings of the children's first grade adjustment. Popularity scores derived from a sociometric procedure will be employed also in the analysis.

B. METHOD

1. *Subjects*

The subjects in the investigation were a group of first graders and their parents. The children were subjects of a larger study dealing with school

* Received in the Editorial Office on March 17, 1961.
1 This research was completed under the sponsorship of the Elizabeth McCormick Memorial Fund of Chicago.

readiness and first grade adjustment. The mean I.Q. of the children was 111.6 according to the Stanford-Binet (Form L) intelligence tests administered by the investigator. The socioeconomic status of the families was approximately evenly divided between the upper-lower and lower-middle classes according to Warner's Index of Status Characteristics (9). The mean ages of the mothers and fathers at the beginning of the study were 32.1 and 34.1 years, respectively, and the corresponding mean years of education were 12.0 and 12.2. Since not all of the parents completed the three instruments, the parent N's vary from 33 to 38 pairs. The adjustment data for the children is based on an N of 35, while the sociometric scores were obtained from one first grade section comprised of 25 children.

2. *Procedure*

a. Parent Measures. The measuring instruments employed in assessing the extent of inter-parent agreement will be described first. Each of these, dealing with some aspect of parental attitude or parental perception of child, have been discussed in more detail in another paper (5). The parent data were all obtained during the year prior to the child's entrance into first grade.

For purposes related to the larger study, each of the parents completed a form of the Parent Attitude Research Instrument (PARI) developed at the National Institute for Mental Health. The development of the scale, its uses and reliability coefficients have been described by the authors (7, 8). Briefly, the scale is a Likert-type questionnaire consisting of 23 subscales each concerned with various aspects of family life, child-rearing attitudes and relationships. Since there are differences between the mother and father forms of the scale, the two forms were examined for identically stated items. Seventy-six such items were abstracted from the two forms. The responses to the PARI items were scored either 4, 3, 2, or 1, depending upon whether the response was "Strongly agree," "Somewhat agree," "Somewhat disagree," or "Strongly disagree," respectively. The difference in response between the mother and father was computed for each item and these were summed for the 76 items. This yielded a disagreement score for each set of parents on the PARI, with the higher score indicating greater disagreement.

Another procedure employed in the larger study involved the Q sort technique (6). Each parent sorted independently two sets of items, one containing only positive traits or characteristics and the other only negative aspects of child behavior. Each pool consisted of 42 items typed on separate cards. The cards were sorted into seven piles ranging from "most charac-

teristic of my child" to "least characteristic of my child," with six cards in each pile. This sort describing the parents' own five-year-old was labeled the "real sort." After these were completed the parents sorted the cards to describe the "ideal" five-year-old; these were known as the "ideal sorts." The piles were numbered from six to zero, with six representing the most characteristic end of the continuum in the real sorts and the most desirable end in the ideal sorts. The difference in placement of each item in the two pools was computed for each set of parents and these were summed separately for the two sorts. These scores, then, represented the extent of disagreement between the parents in their perception of their own five-year-old as well as in their description of the ideal five-year-old.

The scores obtained from one other instrument were included in the present analysis. Since the larger study was concerned with a child's adjustment in first grade, some estimate of the parent's attitude toward a number of aspects of schooling and education in general was desired. An Attitude Toward Education scale (ATE), developed by the writer for this purpose (3), included items covering the following areas: the parent's attitude toward his own educational experiences; the parent's willingness to support the school in matters of discipline, policy, administration, and finances; and the parent's evaluation of the importance of education. The response categories and the scoring for the 40 items were similar to those described for the Parent Attitude Instrument. Based on an N of 68 parent subjects, the computed split-half reliability of the Attitude Toward Education Scale was .90. The disagreement scores were calculated in the same fashion as with the PARI.

b. Child Measures. For the purpose of assessing the subjects' adjustment to the first grade situation, a first grade adjustment scale was developed (4). Based on specific traits, abilities, and items of behavior characterizing good and poor adjustment in first grade mentioned in interviews with 25 first grade teachers, the scale consisted of 52 items grouped into five major areas: I. Physical Status; II. Social Behavior; III. Emotional Behavior; IV. Intellectual Abilities and Behavior; and V. Adjustment to Classroom Membership and Requirements. The traits or characteristics were placed on a five-point scale with "3" representing the midpoint or rating of the "average" child and "1" and "5" describing poor and good adjustment, respectively. Brief descriptive phrases were provided for the end-points. Inter-rater reliability coefficients for the five sections and for the full scale clustered about .75.

One other set of scores was used in the data analysis. A series of sociometric interviews was conducted with the twenty-five children who com-

prised one first grade section (2). The children were asked to name the three children whom they liked best in the class. The subjects' sociometric status scores allowed five points for first choice, three points for second choice, and one point for third choice. The results of the first sociometric interview conducted near the beginning of the school year and the sixth interview held near the end of the year were used.

The analysis of the data involved computing Pearson product-moment correlations between the parents' discrepancy scores on each of the three measures and the children's sociometric and adjustment scores. The expected direction of the correlation coefficients was negative since role theory would suggest that the greater the inter-parent disagreement (i.e., the higher the discrepancy scores), the poorer the child's adjustment and social relationships (i.e., the lower his adjustment and popularity scores).

C. Results

The coefficients obtained from the data analysis appear in Table 1. For the two attitude measures (ATE and PARI) five of the six coefficients were in the expected direction but none was statistically significant. The opposite

TABLE 1
Correlations Between Inter-Parent Discrepancy Scores and the Child's First Grade Adjustment and Popularity

Parent measures	Child measures		
		Sociometrics	
	Adjustment	1st	6th
ATE	—.29	—.38	—.23
PARI	+.07	—.02	—.16
Q sort			
Ideal	—.10	+.37	+.11
Real	+.03	+.14	+.21

Note.—The adjustment data are based on an N of 35 while the sociometric data are based on an N of 25. With N of 35, r of .34 is significant at the .05 level.

was true, however, for the correlations between the parent Q sort procedure and the child measures; again none of the coefficients was significant.

D. Discussion

It is apparent from the coefficients listed in Table 1 that there is little relationship between the extent of parental agreement on the three instruments and the child measures. It should be realized that the discrepancy scores for the attitude scales represented the discrepancy between parental responses on

items tapping a wide and varied number of dimensions. Likewise, the adjustment ratings were based on a great variety of fairly specific traits and characteristics. While it can be concluded from the present findings that parental discrepancy in general is not related to measures of first grade adjustment and popularity, it might be profitable for further research to examine the relationship between parental discrepancy for specific dimensions and specific aspects of the child's behavior and adjustment.

A curvilinear relationship has been postulated between the amount of discrepancy between the parents in their role prescriptions for the child and the child's consequent conflict and maladjustment (6). With too little practice in role playing in the home, the child might well experience difficulty outside of the home when required to meet the demands of other significant adults. When there is too large a discrepancy between the parents in their role prescriptions, conflict might result. While it would seem that the discrepancy scores employed in the present study are adequate operational measures of inter-parent discrepancy in role demands and role prescriptions for the child, scatter-diagrams of the scores for the parent and the child variables do not demonstrate such a relationship.

One further point should be made with regard to the failure to find significant relationships between the two sets of variables. It may be that attitude test data are too far removed from the significant parental influences on the child. The impact which the parental child-rearing practices and modes of behavior exert on the child from day to day remains untapped. There is little research evidence to indicate a relationship between parent attitudes, as assessed by standard parent attitude inventories, and parent behavior. This is to suggest that observational techniques to identify differences between parents in their behavior may reveal consequent child behavior patterns.

E. Summary

The present paper presented data concerning the relationship between inter-parent agreement on three attitude instruments and the child's adjustment and popularity in first grade.

Three instruments, the Parent Attitude Research Instrument, the Attitude Toward Education Scale, and the Q sort procedure were administered to a group of 35 parents. The discrepancy between each set of parents in their responses to the three instruments was related to the teacher's rating of their child's general adjustment in first grade and to the child's popularity as assessed through a sociometric technique.

Low correlation coefficients were obtained in the data analysis. None of the coefficients was statistically significant.

Several suggestions for further research were discussed.

References

1. Leton, D. A. A study of the validity of parent attitude measurement. *Child Develpm.*, 1958, **29**, 515-520.
2. Medinnus, G. R. Several correlates of sociometric status in a first grade group. *J. Genet. Psychol.*, in press.
3. ———. The development of a parent attitude toward education scale. *J. Educ. Res.*, 1962, **56**, 100-103.
4. ———. The development of a first grade adjustment scale. *J. Exp. Educ.*, 1961, **30**, 243-248.
5. ———. The consistency of inter-parent agreement on several measures. *J. Genet. Psychol.*, 1963, **102**, 145-150.
6. ———. Q sort descriptions of five-year-old children by their parents. *Child Develpm.*, 1961, **32**, 473-489.
7. Schaeffer, E. S., & Bell, R. Q. Parental Attitude Research Instrument (PARI) Normative data. Unpubl. manuscript. National Institutes of Health, Bethesda, Md., 1955.
8. ———. Development of a parental attitude research instrument. *Child Develpm.*, 1958, **29**, 339-361.
9. Warner, W. L., Meeker, M., & Eells, K. Social Class in America. Chicago: Science Research Assoc., Inc., 1949.

Psychology Department
San Jose State College
San Jose 14, California

The Journal of Genetic Psychology, 1963, 102, 145-150.

THE CONSISTENCY OF INTER-PARENT AGREEMENT ON SEVERAL MEASURES*[1]

San Jose College

GENE R. MEDINNUS

A. INTRODUCTION AND PROBLEM

While research in the area of parent-child relationships has been burgeoning at a most rapid pace in the past several decades, few significant generalizations can be drawn. Several reasons can be offered to account for this. First, few attempts have been made to relate the research to any theoretical position in psychology. Second, since much current parent-child research typically relates specific child behavior variables to specific parental or home factors, it is difficult to organize the various findings in any meaningful fashion. Third, confusion exists with regard to the antecedent and consequent variables under consideration.

Recently several writers (1, 2) have commented on the need for clarifying the various antecedent units or categories employed in parent-child investigations. Differentiation must be made concerning parental attitudes and beliefs, parental practices (overt behavior), parental personality structure and motives, and the effects of these on the child.

In an attempt to identify some of the problems involved in assessing one of the antecedent units mentioned above, parent attitudes, the present writer has mentioned elsewhere (4) a number of aspects which require research consideration. Several of the problems revolved around the notion of the constancy of parental attitudes through time. Factors producing shifts in parental attitudes, the significance of these changes, and the importance which can be attached to the difference between long- versus short-term constancy of parent attitudes were among the variables listed.

The present paper is concerned with another problem involved in refining and elucidating the antecedent variable, parent attitudes: the degree of consistency in inter-parent agreement (or disagreement) on several attitudinal measures. Role theory would suggest a relation between the extent of parental agreement in various child-rearing attitudes and certain aspects of

* Received in the Editorial Office on March 17, 1961.
[1] This research was completed under the sponsorship of the Elizabeth McCormick Memorial Fund of Chicago.

child behavior, such as evidence of role conflict, ability to adjust to several role expectations and demands, general adjustment, and so forth. In fact, a recent study presented data to support the conclusion that ". . . there is a greater discrepancy between the attitude scores of parents of poorly adjusted children than between parents of well adjusted children" (3, p. 519). It would seem necessary, however, to be concerned also with the consistency of this parental agreement from one measuring instrument to another. The present paper presents data on this point.

B. Method

1. *Subjects*

The parents in the investigation were all parents of five-year-olds who were subjects of a larger study dealing with school readiness and first grade adjustment. The mean IQ of the five-year-olds was 111.6 according to the Stanford-Binet (Form L) intelligence tests administered by the writer. The socio-economic status of the families was approximately evenly divided between the upper-lower and lower-middle classes according to Warner's Index of Status Characteristics (9). The mean ages of the mothers and fathers were 32.1 and 34.1 years, respectively, and the corresponding mean years of education were 12.0 and 12.2. Complete data were available for 34 sets of parents; information on four additional sets of parents was included in part of the data analysis.

2. *Procedure*

Several measuring instruments were employed in assessing the consistency of inter-parent agreement. Each of these, dealing with some aspect of parental attitude or parental perception of child, will be described.

For purposes related to the larger study, each of the parents completed a form of the Parent Attitude Research Instrument (PARI) developed at the National Institute for Mental Health. The development of the scale, its uses and reliability coefficients have been described in some detail by the authors (7, 8). Briefly, the scale is a Likert-type questionnaire consisting of 23 sub-scales each concerned with some aspect of family life, child-rearing attitudes and relationships. Since there are differences between the mother and father forms of the scale, the two forms were examined for identically stated items. Seventy-six such items were abstracted from the two forms. The responses to the PARI items were scored either 4, 3, 2, or 1, depending upon whether the response was "Strongly agree," "Somewhat agree," "Somewhat disagree," or "Strongly disagree," respectively. The

difference in response between the mother and father was computed for each item and these were summed for the 76 items. This yielded a disagreement score for each set of parents on the PARI, with the higher score indicating greater disagreement.

Another procedure employed in the larger study involved the Q sort technique which has been described in another paper (6). Each parent sorted independently two sets of items, one containing only positive traits or characteristics and the other only negative aspects of child behavior. Each pool consisted of 42 items typed on separate cards. The cards were sorted into seven piles ranging from "most characteristic of my child" to "least characteristic of my child," with six cards in each pile. This sort describing the parents own five-year-old was labeled the "real sort." After these were completed the parent subjects sorted the cards to describe the "ideal" five-year-old; these were known as the "ideal sorts." The piles were numbered from six to zero, with six representing the most characteristic end of the continuum in the real sorts and the most desirable end in the ideal sorts. The difference in placement of each item in the two pools was computed for each set of parents and these were summed separately for the real and ideal sorts. These sources, then, represented the extent of disagreement between the parents in their perception of their five-year-old as well as in their description of the ideal five-year-old.

The scores obtained from one other instrument were included in the present analysis. Since the larger study was concerned with a child's adjustment in first grade, some estimate of the parents' attitudes toward a number of aspects of schooling and education in general was desired. An Attitude Toward Education scale (ATE), developed by the writer for this purpose (5), included items covering the following areas: the parent's attitude toward his own educational experiences; the parent's willingness to support the school in matters of discipline, policy, administration, and finances; and the parent's evaluation of the importance of education. A sample of items drawn from the 40 items comprising the Attitude Toward Education scale is listed below.

On the whole schools do a good job in cooperating with parents.

Parents should back up the school in matters of discipline.

Schools teach a lot of things that don't work out when you actually get on the job.

Some boys and girls are always getting tough breaks in school.

Most schools don't let the parents know enough about what's going on.

The school is often to blame in cases where students don't like school.
Children should listen to the teacher and do what she says.

The response categories and the scoring were similar to those described for the Parent Attitude Research Intrument. Based on an N of 68 parent subjects, the computed split-half reliability of the Attitude Toward Education scale was .90. The disagreement scores were calculated in the same fashion as with the PARI.

3. *Data Analysis*

Although the present paper is concerned not with the extent of parental agreement on the various measures but with the consistency of this agreement among the measures, the former information is tabulated in Table 1.

The analysis of the data involved computing Pearson *r*'s between the parents' disagreement scores for the several measures.

C. Results

It is apparent from the coefficients listed in Table 1 that there was not high agreement between the parents on any of the instruments employed.

TABLE 1
INTER-PARENT AGREEMENT COEFFICIENTS

Measures	r*
PARI (N = 34)	.42
Q sorts (N = 38)	
Ideal sort	
Plus pool	.28
Minus pool	.30
Real sort	
Plus pool	.40
Minus pool	.43
ATE (N = 34)	.29

* For N = 34, .44 signif. at < .01 level.

The possible implications of this in terms of the relation between parental agreement and various child measures will be discussed in another paper.

The correlation coefficients among the various measures described above are provided in Table 2. Not only are none of the coefficients statistically significant but half of them are in the opposite direction from what would be predicted.

TABLE 2
CONSISTENCY OF PARENTAL AGREEMENT AMONG SEVERAL ATTITUDE MEASURES

	Q sorts		
	Ideal	Real	ATE
PARI	.20	—.06	.22
Q sorts			
Ideal		.10	—.31
Real			—.31

D. DISCUSSION

It is interesting to note the low coefficient obtained between the parents' agreement scores for the real and ideal Q sorts. There would appear to be no relation between the extent to which parents agree in their perception of their child on the one hand and in their behavioral goals for him and the importance they attach to various aspects of child behavior on the other. If the individual inter-parent agreement coefficients represent a measure of the extent of the parents' communication, it would seem that the degree of communication is quite specific to any given area of mutual concern. One might expect that inter-parent communication is a fairly generalized characteristic of any one parent pair, that parents who agree closely in their description of their own child would also show high agreement in their description of the ideal child. The low coefficient obtained between the agreement scores for these two measures indicates that such is not the case.

The implications of the present findings for further parent-child research are several. First, an investigator must be careful to describe the specific attitude scale employed as well as the nature of the attitudes which it taps if he is attempting to relate the extent of parental agreement to child behavior. It is not valid to generalize the findings to other parent or child dimensions. Second, it is apparent that inter-parent agreement is fairly specific in nature with little general consistency. It would seem fruitful to explore the possible factors involved which produce this lack of consistency. One might speculate certainly with regard to personality differences between parents, differences in their value systems, and in their various needs and motivations. Third, since little general inter-parent consistency was found, it might be profitable to examine the effects of inter-parent agreement in specific areas on specific dimensions of child adjustment. Perhaps, also, the *pattern* of agreement for any one set of parents on various measures exerts a significant influence on the child in terms of role demands and role adjustments.

E. Summary

The present paper presented data concerning the consistency of inter-parent agreement among several attitudinal measures.

Three instruments, the Parent Attitude Research Instrument, the Attitude Toward Education scale, and the Q sort procedure were administered to 34 sets of parents. All of the subjects were parents of five-year-olds who were subjects of a larger investigation dealing with school readiness and first grade adjustment.

Low correlation coefficients were obtained for the parent agreement scores among the measures employed. This would point to a lack of consistency in the extent to which any one set of parents agree with regard to their attitudes toward a number of aspects of child rearing, toward education, and in their perception of and goals for their child.

The implications of these findings for further parent-child research were discussed.

References

1. Baldwin, A. L. Child Psychology. *In* Farnsworth, P. R., & McNemar, Q. (*Eds.*), *Annual Review of Psychology*. Stanford, Calif.: Annual Reviews, 1956, 259-282.
2. Brim, O. G., Jr. The parent-child relation as a social system: I. Parent and child roles. *Child Developm.*, 1957, **28**, 343-364.
3. Leton, D. A. A study of the validity of parent attitude measurement. *Child Developm.*, 1958, **29**, 515-520.
4. Medinnus, G. R. Research implications of several parent-child concepts. *Marr. Fam. Living*, 1959, **21**, 329-333.
5. ———. The development of a parent attitude toward education scale. *J. Educ. Res.*, 1962, **56**, 100-103.
6. ———. Q sort descriptions of five-year-old children by their parents. Unpubl. manuscript.
7. Schaeffer, E. S., & Bell, R. Q. Parental Attitude Research Instrument (PARI). Normative data. Unpubl. manuscript. National Institutes of Health, Bethesda, Md., 1955.
8. ———. Development of a parental attitude research instrument. *Child Developm.*, 1958, **29**, 339-361.
9. Warner, W. L., Meeker, M., & Eels, K. Social Class in America. Chicago: Science Research Associates, Inc., 1949.

Psychology Department
San Jose State College
San Jose 14, California

The Journal of Genetic Psychology, 1963, **102**, 151-157.

A STUDY OF FRIENDSHIP FLUCTUATIONS OF COLLEGE STUDENTS*

The Ohio State University

Carol A. Skorepa, John E. Horrocks, and George G. Thompson

A. Introduction

The purpose of this study was to investigate the friendship fluctuations of college students. In two earlier studies Horrocks and Thompson (2) and Thompson and Horrocks (3) investigated the friendship fluctuations of adolescents. Then, in a later study, Horrocks and Buker (1) extended the research to include a population of preadolescents. The present study may be considered as an extension of these earlier studies.

B. Subjects

The sample consisted of 503 college students enrolled in elementary educational psychology during the autumn (Sept. 28–Dec. 18, 1959) and winter (Jan. 4–Mar. 18, 1960) quarters at the Ohio State University. This course is required for all students entering the college of education. The number of males was 176 and the number of females was 327. Since there are many more females in the college of education, there are fewer males in the sample. Also there are fewer subjects at the older age levels in college. It seemed reasonable to put the 22- to 24-year-olds in one group, since they represent what might be called early maturity. Likewise the 25- to 35-year-olds were put into a group representing middle maturity.

C. Procedure

The procedures used in this study are identical to those used in the earlier studies (1, 3). Each subject was presented a sociometric questionnaire on which the following instructions were printed:

> Please write below the names of the people that you regard as your three best friends. List the one that you like best, first; the second best, second; and the third best, third.

Since in the earlier studies the subjects were asked to limit their choices to people they knew in the school, the subjects in the present study were asked

* Received in the Editorial Office on March 23, 1961.

to limit their choices to people they knew at the Ohio State University.

Two weeks later each subject was again presented with the same sociometric questionnaire but with this addition to the instructions:

> The people you list this time *may or may not* be those you listed before.

D. Analysis of Data

The index adopted to measure the fluctuations was one devised by Horrocks and Thompson (2). The following procedure was employed as a means of computing the fluctuation index:

> (a) The three friends chosen by each subject during the second choice situation were compared with the three friends chosen two weeks previously.
>
> (b) If the friends chosen the second time duplicated in personage and rank order the friends chosen two weeks previously, the index of friendship fluctuation was considered to be zero.
>
> (c) If the friends chosen the second time duplicated in personage but differed in rank order from the friends chosen two weeks previously, an index of friendship fluctuation was computed by assigning a numerical value of one to each rank that a friend of the second choice situation was separated from the rank initially assigned to him; e.g., if the original ranking were: like best, John; second best, Bill; third best, Carl; and the second ranking were: like best, Carl; second best, John; third best, Bill; the fluctuation index as computed by this procedure would be four; since Carl is removed two ranks, Bill one rank, and John one rank from the original rankings.
>
> (d) If a subject during the second choice situation chose among his three best friends boys or girls whom he had not previously chosen, the following numerical values were assigned to these *new* friends: two for a person not previously mentioned who became the subject's third-best friend during the second choice situation, three for a person not previously mentioned who became the subject's second-best friend, and four for a person not previously mentioned who became the subject's best friend.

Although these numerical values were determined on a rational rather than an empirical basis, Horrocks and Thompson (2) note that this type of analysis provides suitable data for a crude, over-all index of friendship fluctuation. Precision which may be lost in an analysis like this is compensated for because one is able to evaluate simultaneously all the complex data on friendship changes (2).

E. Results

The scores ranged from 0 (no fluctuation over the two-week period) to nine (the total for the highest possible fluctuation over the two-week period).

The means and standard deviations for each chronological age group were as follows: age 19, $M = 2.84$, $SD = 2.29$; age 20, $M = 2.93$, $SD = 2.26$; age 21, $M = 3.35$, $SD = 2.60$; age 22-24, $M = 2.73$, $SD = 2.34$; age 25-35, $M = 2.71$, $SD = 2.31$. The relatively high degree of variability between individual subjects can be seen in the large standard deviations.

1. *Sex Differences*

Statistical comparisons for significant differences between males and females of the sample were performed. The means and standard deviations for the males and females for each chronological age group were as follows: age 19—male, $M = 3.22$, $SD = 2.15$—female, $M = 2.76$, $SD = 2.31$; age 20—male, $M = 2.73$, $SD = 1.59$—female, $M = 3.01$, $SD = 2.46$; age 21—male, $M = 3.23$, $SD = 2.60$—female, $M = 3.54$, $SD = 2.59$; age 22-24—male, $M = 3.10$, $SD = 2.31$—female, $M = 2.16$, $SD = 2.28$; age 25-35—male, $M = 3.15$, $SD = 2.30$—female, $M = 1.73$, $SD = 2.02$. The results show that a t ratio of 2.02 is significant at the .05 level for the age group 25–35. The differences between the means of the males and females for the other chronological age groups were not significant at acceptable levels of confidence.

2. *Age Differences*

The means of each group were compared with the means of every other age group. No significant differences were demonstrated at acceptable levels of confidence.

3. *Comparison to Earlier Studies*

The data of the present study were combined with the data of two earlier studies—Thompson and Horrocks (3) and Horrocks and Buker (1)—and are presented graphically in Figure 1. These data show a consistent downward trend with increasing chronological age until about age 19. At this point there is a rise in fluctuation. It reaches a peak at age 21 and then tapers off again. The results of a statistical analysis comparing the fluctuation indices of each chronological age group with every other chronological age group was performed. The obtained t's indicate that the mean fluctuation index of the 19- through 35-year-olds is significantly lower than the mean fluctuation indices of the five- through nine-year-olds with one exception. This exception is between nine- and 21-year-olds. There are no significant differences between the mean fluctuation indices of the 19- through 35-year-olds and the mean fluctuation index of the 10-year-olds. There also seem to be significant differ-

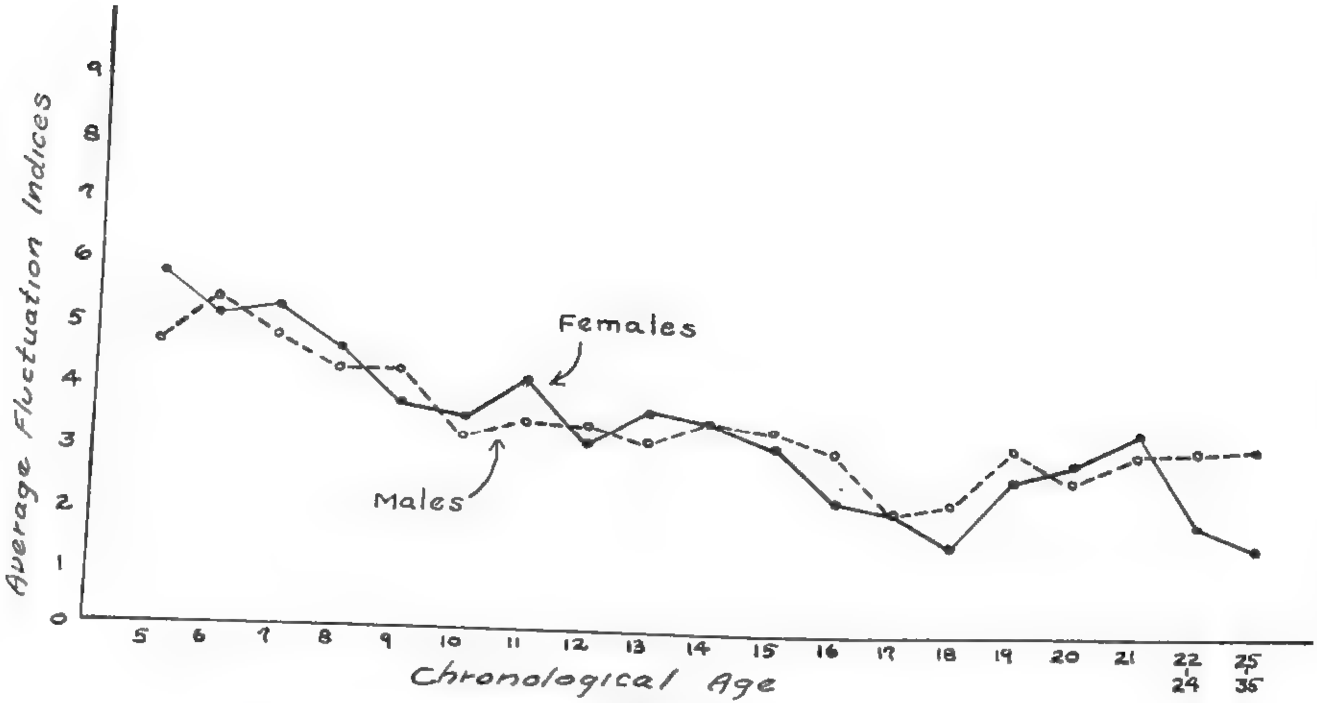

FIGURE 1
THE RELATIONSHIP BETWEEN CHRONOLOGICAL AGE AND FRIENDSHIP FLUCTUATION FOR A SAMPLE OF 1018 FEMALES AND 775 MALES

ences between 19, 20, and 25–35-year-olds and 11- and 13-year-olds; 19, 20, and 22–24, and 25–35-year-olds and 14-year-olds; 19, 20, and 21-year-olds and 17- and 18-year-olds.

4. *Differences in College Classification*

An additional analysis was carried out in order to examine the effect the number of years in college might have on stability of friendship selections over the two-week period. Information concerning the number of hours completed at the time of participation in the study was obtained from University files. A five-by-four contingency table was set up with the four college classifications (Freshman, Sophomore, Junior and Senior) on one axis and the fluctuation indices on the other. The indices were divided into the following five groups: 0–1, 2–3, 4–5, 6–7, and 8–9. The obtained chi-square of 13.6676 with 12 degrees of freedom was not significant at an acceptable level of confidence. There does not appear to be any relationship between index of fluctuation and the number of years spent in college.

F. Discussion

The subjects used in the Thompson and Horrocks (3) study were urban adolescents and the subjects used by Horrocks and Buker (1) were elementary school children from an urban setting. A large majority of the subjects in the present sample may be classified as urban, however, a small percentage of the population is rural.

The subjects used in the two previous studies all attended public school systems and it seems, therefore, that they are more representative of the general population than are the subjects of the present study. College students represent a more select population in regard to intelligence and socioeconomic status. Whatever effect these two factors have on friendship fluctuation is unknown at the present time. Also in regard to the sample population, it is heavily weighted with female subjects. This makes generalizations from the findings less applicable to male subjects. It should further be noted that the number of subjects between ages 22 and 35 is quite small in comparison to the number of subjects between ages 19 and 21.

The procedures followed in the present study were identical to those used in the two earlier studies. However, the question of whether or not the data are comparable must seriously be asked. The age range of these three studies combined covers a span of 30 years and the two-week interval between administrations of the questionnaire was held constant for all. It seems

that two weeks in the life of a five-year-old is not equivalent to two weeks in the life of a twenty- or thirty-five-year-old.

The data show a consistent downward trend from age five through age 18, however, at this point the fluctuation begins to increase. It seems possible that this rise in friendship fluctuation after age 18 may be due to the breaking up of a closed community from which selections were made. Eighteen is the approximate age of high school graduates. This seems to be a transition point and the next few years (approximately ages 19, 20 and 21) are spent settling in an occupation, serving in the armed forces, continuing formal education, or adjusting to married life. For the most part, it seems that a relatively closed group of people from which friends were formerly selected has now been opened up to include a vast number of others, thus the rise in the fluctuation of friendships. This interpretation can only be proposed for the subjects included in the present study—college students. Further research is, therefore, necessary in regard to groups of people, other than college students, who fall within these chronological age classifications. It would also be interesting to continue the investigation of friendship fluctuation with increasing age on a population representing late maturity and old age.

G. Summary

The purpose of this study was to investigate the friendship fluctuations of college students as an extension of two earlier studies. The subjects used were 503 students enrolled in elementary educational psychology and ranging in age from 19 to 35. A sociometric questionnaire was presented on two occasions with a two-week period between administrations. An index of fluctuation was computed for each subject and the results of the statistical analysis are as follows: (*a*) there are no significant differences between the sexes except for age group 25–35; (*b*) there are no significant differences between the various chronological age groups from 19 to 35; (*c*) the number of years spent in college does not seem to be an important determiner of friendship fluctuation; (*d*) there is a somewhat consistent downward trend in friendship fluctuation from age five to age 18; at this point there is a rise which reaches its peak at age 21. It was hypothesized that this rise in fluctuation might be due to a transition to college and the opening up of a new and diverse source of potential friends.

References

1. Horrocks, J. E., & Buker, M. E. A study of the friendship fluctuations of preadolescents. *J. Genet. Psychol.*, 1949, **78**, 131-144.

2. Horrocks, J. E., & Thompson, G. G. A study of friendship fluctuations of rural boys and girls. *J. Genet. Psychol.*, 1946, **69**, 189-198.
3. Thompson, G. G., & Horrocks, J. E. A study of the friendship fluctuations of urban boys and girls. *J. Genet. Psychol.*, 1947, **70**, 53-63.

Department of Psychology
The Ohio State University
Columbus 10, Ohio

The Journal of Genetic Psychology, 1963, **102**, 159-165.

BAR PRESSING AS A FUNCTION OF TEST ENVIRONMENT AREA*[1]

University of Maine

Alan Baron, Joseph J. Antonitis, and Alton H. Clark

A. Introduction

The purpose of the present study was to obtain information concerning the influence of the area of the test environment and of a luminescent cue in the region of the bar on the operant level or "unconditioned" rate of bar pressing in mice.

That area of the test environment may function to determine unconditioned response frequency was suggested by the "general activity" hypothesis which has been offered by Hefferline (3) and Schoenfeld, Antonitis, and Bersh (6), in conjunction with what might be termed an "unconditioned reserve" hypothesis (1), to explain phenomena of unconditioned bar pressing. A strict interpretation of the activity hypothesis leads to the conclusion that unconditioned bar pressing is in large part the result of fortuitous movements of the subject in the test environment. If the subject placed in a uniform environment is generally active, i.e., active equally in all parts of the environment, it follows that fewer bar presses would be emitted in a large than in a small environment since in a large environment the probability of fortuitous bar presses would be reduced. A reasonable prediction from the activity hypothesis is that as the environment is made larger, the number of bar presses emitted will be inversely proportional to the area of the environment, e.g., doubling the area should result in halving the number of bar presses.

The present study was designed primarily to test the preceding prediction from the activity hypothesis. This was done by observing the unconditioned bar-pressing behavior of mice in four test environments differing widely in area. In designing the experiment, the question arose whether the rate of bar pressing might also be influenced by the perceptibility of the bar in the test environment. Accordingly, the design was elaborated to determine what effect, if any, faint illumination in the region of the bar might have on the behavior studied.

* Received in the Editorial Office on April 12, 1961.

[1] This research was supported, in part, by Grant R625-DY from the Wilson Coe Research Fund.

B. Subjects

Forty experimentally naive mature male mice of the C57 Black Subline 6 strain were selected from the laboratory colony and were assigned randomly to the experimental conditions described below.

C. Apparatus

Observations were conducted in four identical square test boxes of wooden construction with hardware cloth floors and opaque tops. By adding false walls, each test box could be varied among four areas: 10.6 square inches (3-1/4-inch sides), 30.3 square inches (5-1/2-inch sides), 121.0 square inches (11-inch sides), and 484.0 square inches (22-inch sides). All interior walls were painted white.

Positioned at the midline of one wall of each box, 5/8 inch above the floor and extending 1/2 inch into the box, was a T-shaped aluminum bar whose cross-piece measured two inches. A downward pressure upon the bar of about 2 gm. through an excursion of 3/16 inch closed a switch and defined a bar-press response. Mounted directly above each bar was a Sylvania *Panelescent* electroluminescent disk, two inches in diameter, which when operated at 30 v. produced an even disk of green luminescence faintly visible to the human eye.

The number of bar presses was recorded at five-minute intervals on printing counters, and the total time that the bar remained depressed during each one-hour test period was read to the nearest .01 minute from self-starting electric time meters. All recording and programming equipment was located in a room adjoining the test room, and extraneous noises were masked by the continuous sound of an electric fan operated within the test room itself.

D. Procedure

The experiment followed a 4 $\times$ 2 factorial design, five subjects per cell, in which the main variables were *box area,* i.e., 10.6 square inches, 30.3 square inches, 121.0 square inches, and 484.0 square inches, and *illumination,* i.e., the presence or absence of the luminescent cue in the region of the bar.

Each subject was removed from its communal living cage where food and water were continually available and immediately observed in the test situation for one hour. Four subjects were simultaneously tested per hour, and during a given two-hour period one member of each of the eight subgroups was observed. The association of the four response bars and the four test

boxes was systematically rotated so that any variation attributable to the bars was distributed among all conditions of box size and illumination.

E. Results

The response frequency and response time data obtained during the one-hour test sessions were evaluated through analyses of variance. These analyses yielded parallel conclusions for both response measures: increases in the area of the test box resulted in progressive decreases in the total number of bar presses ($F = 6.12$, df 3 and 32, $p < .01$) and in the total time that the bar remained in the depressed position ($F = 5.84$, df 3 and 32, $p < .01$). But the presence or absence of the luminescent cue above the bar and the interaction between cue and box area were not reliable sources of intergroup variation in either the response frequency or the response time analysis.

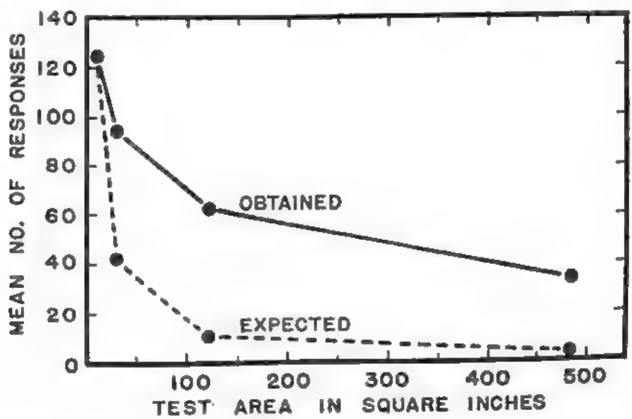

FIGURE 1

Mean numbers of bar-press responses actually made by four groups of mice observed in different-size test areas, i.e., 10.6 square inches, 30.3 square inches, 121.0 square inches, and 484.0 square inches, and mean numbers of bar-press responses that were theoretically expected in these test areas from an interpretation of the activity hypothesis.

Figure 1 shows the mean numbers of bar-press responses made by members of each of the four box-area groups. Also shown in the figure is a theoretical curve representing the numbers of responses that would be expected if frequency of bar pressing were inversely proportional to increases in box area. In deriving this curve expected response frequencies were determined as proportions of the mean numbers of responses emitted in the smallest test box. Inspection of Figure 1 indicates that while fewer responses occurred in the larger boxes than in the smaller ones, the response decrements accompany-

ing increases in box area were less than would be expected were the relationship between response frequency and box area inversely proportional in the manner predicted. In all three possible comparisons, differences between obtained means and theoretically expected values attained acceptable levels of significance using two-tailed tests: in the 30.3 square inches box, $t = 4.35$ (df 9, $p < .01$), in the 121.0 square inches box, $t = 3.21$ (df 9, $p < .02$) and in the 484.0 square inches box, $t = 2.40$ (df 9, $p < .05$).

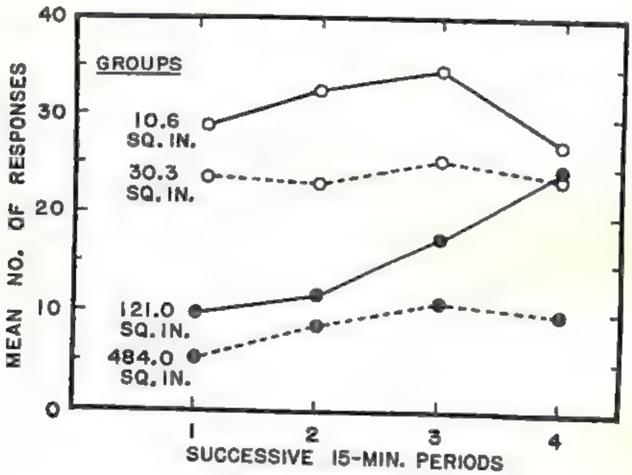

FIGURE 2
Intrasession Bar-Press Rates of Four Groups of Mice in Different-Size Test Areas

Presented in Figure 2 are the intrasession response rates of the members of each of the four box-area groups analyzed in 15-minute periods. Here it may be seen that the subjects observed in the two smallest-size boxes responded at continued high rates throughout the one-hour test session. By contrast, the subjects observed in the two larger boxes, after responding at low rates during the initial 15 minutes, showed increases in their rates of responses during the test session. For the subjects in the 121 square inch box and the subjects in the 484 square inch box the increases in response rates from the first 15-minute period to the last 15-minute period were significant at least at the five per cent level of confidence by Wilcoxen's nonparametric test for paired replicates.

F. Discussion

While the results of the present study have shown that unconditioned bar pressing is inversely related to the area of the test environment, the relation-

ship does not appear to be the proportional one derived from certain implications of the activity hypothesis. The analyses of the data indicate, rather, that as the area of the test environment was increased, the subjects emitted a disproportionately greater number of responses than was expected. Further, the observed intrasession response patterns are difficult to account for as simply reflecting the fortuitous general movements of the subjects within the different-size environments. In the instances of the subjects observed in the two largest-size environments, the intrasession response records clearly show increased concentration of activity in the region of the bar as the test session progressed.

The results of this experiment appear to bear out implications of Woodworth's "behavior primacy" interpretation of unconditioned bar pressing (7) to a greater degree than the implications of the activity hypothesis. According to the behavior primacy theory, unconditioned bar pressing is, in actuality, a conditioned form of behavior stemming from the behavioral capacities of the subject and strengthened by the self-reinforcement provided by the expression of the bar-press response. In the present study, it may be argued, the act of bar pressing provided the subjects with sensory-reinforcing consequences otherwise not obtainable in the test environments. The disproportionately high numbers of responses emitted by the subjects in the larger environment may be pointed to as substantiating the view that the bar-press response was mediating such reinforcement.

The behavior primacy theory also provides a reasonable explanation of the character of the obtained intrasession distributions of responses. Woodworth's theory suggests that variations in the area of a bar-pressing environment will influence the number of cues that may compete with those contingent upon bar pressing as well as the amount of exploration required before the bar is located. The operation of these two factors may be used to account for the findings in the present study that rates of responses by subjects in the smaller environments were consistently high while rates of responses by subjects in the larger environments were initially low but then increased. It may be argued that in the small environments where the subjects could locate the bar readily and where there were few competing cues, the bar-press response was strengthened early in the test session to a near maximal level which was maintained to the end. By contrast, in the larger test areas where subjects were required to explore the environment before the bar could be located and where the number of competing cues was high, bar pressing was infrequent early in the session, but increased markedly as the unique reinforcement provided by the bar-press response was encountered. The preceding explanation of the results of the present study is consistent with explanations

of unconditioned forms of behavior that have been offered in the past by Kish and Antonitis (5), Baron, Antonitis, and Beale (2), and Antonitis and Baron (1).

An unexpected finding of the present study was that the presence of the light over the bar did not appear to influence rates of responding. Other studies have indicated that dim lights have reinforcing value for rodents (e.g., 4), and on this basis it was expected that a continuous light over the bar would attract behavior to the region of the bar. It is possible, however, that the level of illumination in the present study either was too dim to be perceived by the subjects or that its character, if perceived, was simply not reinforcing for the subjects.

G. Summary

The rate of unconditioned bar pressing by mice was found to decrease as a function of increases in the area of the environment in which the response bar was located but was not influenced by the presence of a faint luminescent cue above the bar. The subjects observed in the two smaller test environments of the study responded at consistently high rates during the one-hour test session while the subjects observed in the two larger environments at first responded at low rates, the rates increasing significantly as the test session progressed.

The results were discussed in terms of two explanations which have been offered for unconditioned bar pressing: an interpretation of the activity hypothesis which accounts for unconditioned bar pressing as a result of fortuitous movements, and Woodworth's behavior primacy theory which accounts for unconditioned bar pressing as a result of reinforcement mediated by the expression of the response. The behavior primacy theory was held to provide the more satisfactory explanation of the results of the study.

References

1. Antonitis, J. J., & Baron, A. A test of the hypothesis of an unconditioned reserve. *J. Comp. & Physiol. Psychol.*, 1961, **54**, 457-460.
2. Baron, A., Antonitis, J. J., & Beale, R. H. Effects of activity deprivation upon bar pressing. *J. Comp. & Physiol. Psychol.*, 1961, **54**, 291-293.
3. Hefferline, R. F. An experimental study of avoidance. *Genet. Psychol. Monog.*, 1950, **42**, 231-334.
4. Kish, G. B. Learning when the onset of illumination is used as reinforcing stimulus. *J. Comp. & Physiol. Psychol.*, 1955, **48**, 261-264.
5. Kish, G. B., & Antonitis, J. J. Unconditioned operant behavior in two homozygous strains of mice. *J. Genet. Psychol.*, 1956, **88**, 121-129.

6. SCHOENFELD, W. N., ANTONITIS, J. J., & BERSH, P. J. Unconditioned response rate of the white rat in a bar pressing apparatus. *J. Comp. & Physiol. Psychol.*, 1950, **43**, 41-48.

7. WOODWORTH, R. S. Dynamics of Behavior. New York: Holt, 1958.

Department of Psychology
University of Wisconsin—Milwaukee
Milwaukee 11, Wisconsin

The Journal of Genetic Psychology, 1963, 102, 167-171.

BOOKS

Now that there is a special *APA* journal completely devoted to the publication of book reviews, it is no longer necessary that other journals emphasize such publication. It has always been our conviction that book reviews are a secondary order of publication unless they carry information that is equally important as the book. However, the publication of book titles is a very important service, and we shall continue to render that service.

In any given issue of this journal, we may continue to publish one or more book reviews, but we do not consider such publication a major function of this journal. In line with this policy, we can no longer pay for such manuscripts.

BOOKS RECENTLY PUBLISHED

Bachrach, A. J., *Ed.* Experimental Foundations of Clinical Psychology. New York: Basic Books, 1962. Pp. 649.

Berg, C. Madkind: The Origin and Development of the Mind. New York: Hillary House, 1962. Pp. 227.

Blair, G. M., Jones, R. S., & Simpson, R. H. Education Psychology: Second Edition. New York: Macmillan, 1962. Pp. 678.

Briggs, K. M. Pale Hecate's Team. New York: Humanities Press, 1962. Pp. 291.

Brill, A. A. Freud's Contribution to Psychiatry. New York: Norton, 1962. Pp. 244.

Bruner, J. S. On Knowing: Essays for the Left Hand. Cambridge, Mass.: Harvard Univ. Press, 1962. Pp. 165.

Brussel, J. A. The Layman's Guide to Psychiatry. New York: Barnes & Noble, 1961. Pp. 235.

Cantoni, L. J., & Cantoni, L. Counseling Your Friends: Techniques in Psychotherapy for the Layman. New York: William-Frederick Press, 1961. Pp. 105.

Caprio, F. S. The Power of Sex. New York: Citadel Press, 1962. Pp. 228.

Chapple, E. D., & Sayles, L. R. The Measure of Management Designing Organization for Human Effectiveness. New York: Macmillan, 1961. Pp. 218.

Cowen, E. L., Underberg, R. P., Verillo, R. T., & Benham, F. G. Adjustment to Visual Disability in Adolescence. New York: American Foundation for the Blind, 1961. Pp. 239.

Cram, D. Explaining "Teaching Machines" and Programming. San Francisco: Fearon Publishers, 1961. Pp. 87.

Crombie, I. M. An Examination of Plato's Doctrines: 1. Plato on Man and Society. New York: Humanities Press, 1962. Pp. 395.

Daniel, J. P. Child of Fury: The Story of the Psychological Development of a Psychotic Child. New York: Exposition Press, 1961. Pp. 78.

Des Lauriers, A. M. The Experience of Reality in Childhood Schizophrenia. New York: International Univs. Press, 1962. Pp. 215.

Desmonde, W. H. Magic, Myth, and Money: The Origin of Money in Religious Ritual. New York: Free Press of Glencoe, 1962. Pp. 208.

DeVries, E. Man in Rapid Social Change. Garden City, N.Y.: Doubleday, 1961. Pp. 240.

DILL, W. R., HILTON, T. L., & REITMAN, W. R. The New Managers: Patterns of Behavior and Development. Englewood Cliffs, N.J.: Prentice-Hall, 1962. Pp. 258.

DOBSHANSKY, T. Mankind Evolving: The Evolution of the Human Species. New Haven: Yale Univ. Press, 1962. Pp. 381.

DRY, A. H. The Psychology of Jung: A Critical Interpretation. New York: Wiley, 1961. Pp. 329.

EIDUSON, B. T. Scientists: Their Psychological World. New York: Basic Books, 1962. Pp. 299.

ENGEL, G. L. Fainting: Second Edition. Springfield, Ill.: Charles C Thomas, 1962. Pp. 196.

ESSIEN-UDOM, E. U. Black Nationalism: A Search for an Identity in America. Chicago: Univ. Chicago Press, 1962. Pp. 367.

EYSENCK, H. J., *Ed.* Behaviour Therapy and the Neuroses. New York: Pergamon Press, 1960. Pp. 479.

FISKE, D. W., & MADDI, S. R. Functions of Varied Experience. Homewood, Ill.: The Dorsey Press, 1961. Pp. 501.

FROMM, E. May Man Prevail?: An Inquiry into the Facts and Fictions of Foreign Policy. Garden City, N.Y.: Doubleday, 1961. Pp. 252.

GARNER, W. R. Uncertainty and Structure as Psychological Concepts. New York: Wiley, 1962. Pp. 369.

GELDARD, F. A. Fundamentals of Psychology. New York: Wiley, 1962. Pp. 437.

GOFFMAN, E. Encounters: Two Studies in the Sociology of Interaction. Indianapolis: Bobbs-Merrill, 1961. Pp. 152.

GOLEMBIEWSKI, R. T. The Small Group: An Analysis of Research Concepts and Operations. Chicago: Univ. Chicago Press, 1962. Pp. 303.

GOTTSCHALK, L. A., *Ed.* Comparative Psycholinguistic Analysis of Two Psychotherapeutic Interviews. New York: International Univs. Press, 1961. Pp. 221.

GREENBERGER, M., *Ed.* Management and the Computer of the Future. New York: Wiley, 1962. Pp. 340.

GREGORY, I. Psychiatry: Biological and Social. Philadelphia: W. B. Saunders, 1961. Pp. 577.

GUNTRIP, H. Personality Structure and Human Interaction: The Developing Synthesis of Psycho-dynamic Theory. New York: International Press, 1961. Pp. 456.

HAIRE, M., *Ed.* Organization Theory in Industrial Practice: A Symposium of the Foundation of Research on Human Behavior. New York: Wiley, 1962. Pp. 173.

HARING, N. G., & PHILLIPS, E. L. Educating Emotionally Disturbed Children. New York: McGraw-Hill, 1962. Pp. 322.

HARRIS, A. J. Effective Teaching of Reading. New York: David McKay, 1962. Pp. 387.

HAVIGHURST, R. J., BOWMAN, P. H., LIDDLE, G. P., MATTHEWS, C. V., & PIERCE, J. V. Growing Up in River City. New York: Wiley, 1962, Pp. 189.

HENRICH, E., & KRIEGEL, L. Experiments in Survival. New York: Association for the Aid of Crippled Children, 1961. Pp. 199.

HIRT, M. A Career as a Psychologist. Cambridge, Mass.: Bellman Publishing Co., 1962. Pp. 26.

HOCH, P. H., & ZUBIN, J., *Eds.* The Future of Psychiatry. New York: Grune & Stratton, 1962. Pp. 271.

HOMANS, G. C. Sentiments and Activities: Essays in Social Science. New York: Glencoe, 1962. Pp. 326.

HUNT, J. M. Intelligence and Experience. New York: Ronald Press, 1961. Pp. 416.

JAYNE, W. A. The Healing Gods of Ancient Civilizations. New Hyde Park, N.Y.: University Books, 1962. Pp. 569.

JENNINGS, E. E. The Executive: Autocrat, Bureaucrat, Democrat. New York: Harper & Row, 1962. Pp. 272.

KARE, M. R., & HALPERN, B. P., *Eds.* Physiological and Behavioral Aspects of Taste. Chicago: Univ. Chicago Press, 1961. Pp. 149.

KEESING, F. M. The Ethnohistory of Northern Luzon. Stanford, Calif.: Stanford Univ. Press, 1962. Pp. 362.

KLAPP, O. E. Heroes, Villains and Fools: The Changing American Character. Englewood Cliffs, N.J.: Prentice-Hall, 1962. Pp. 175.

KLEIST, K. Sensory Aphasia and Amusia: The Myeloarchitectonic Basis. New York: Pergamon Press, 1962. Pp. 95.

KLUCKHOHN, R., *Ed.* Culture and Behavior: The Collected Essays of Clyde Kluckhohn. New York: Free Press of Glencoe, 1962. Pp. 402.

KRECH, D., CRUTCHFIELD, R. S., & BALLACHEY, E. L. Individual in Society: A Textbook of Social Psychology. New York: McGraw-Hill, 1962. Pp. 564.

LAWRENCE, D. H., & FESTINGER, L. Deterrents and Reinforcement: The Psychology of Insufficient Reward. Stanford, Calif.: Stanford Univ. Press, 1962. Pp. 180.

LENNHOFF, F. G. Exceptional Children: Residential Treatment of Emotionally Disturbed Boys at Shotton Hall. New York: Taplinger, 1962. Pp. 201.

LEVITT, E. E. Clinical Research Design and Analysis in the Behavioral Sciences. Springfield, Ill.: Charles C Thomas, 1961. Pp. 199.

LICHTER, S. O., RAPIEN, E. B., SEIBERT, F. M., & SKLANSKY, M. A. The Drop-Outs: A Treatment Study of Intellectually Capable Students Who Drop Out of High School. New York: Free Press of Glencoe, 1962. Pp. 302.

MEERLOO, J. A. M. That Difficult Peace. Great Neck, N.Y.: Channel Press, 1961. Pp. 190.

MOK, P. P. A View from Within: American Education at the Crossroads of Individualism. New York: Carlton Press, 1962. Pp. 191.

MORGAN, J. N., DAVID, M. H., COHEN, W. J., & BRAZER, H. E. Income and Welfare in the United States. New York: McGraw-Hill, 1962. Pp. 531.

MUENSTERBERGER, W., & AXELRAD, S., *Eds.* The Psychoanalytic Study of Society: Volume II. New York: International Univs. Press, 1962. Pp. 317.

NASH, H. Alcohol and Caffeine. Springfield, Ill.: Charles C Thomas, 1962. Pp. 169.

NOSOW, S., & FORM, W. H., *Eds.* Man, Work, and Society: A Reader in the Sociology of Occupations. New York: Basic Books, 1962. Pp. 612.

OSBORN, A. W. The Future Is Now: The Significance of Precognition. New Hyde Park, N.Y.: University Books, 1961. Pp. 254.

PAP, A. An Introduction to the Philosophy of Science. New York: Free Press of Glencoe, 1962. Pp. 444.

PATTERSON, C. H. Counseling and Guidance in Schools: A First Course. New York: Harper, 1962. Pp. 382.

PYE, L. W. Politics, Personality, and Nation Building: Burma's Search for Identity. New Haven, Conn.: Yale Univ. Press, 1962. Pp. 307.

RADZINOWICZ, L. In Search of Criminology. Cambridge, Mass.: Harvard Univ. Press, 1962. Pp. 254.

RAPOPORT, A. Fights, Games, and Debates. Ann Arbor: Univ. Michigan Press, 1960. Pp. 400.

REISS, S. The Basis of Scientific Thinking. New York: Philosophical Library, 1961. Pp. 262.

RIESSMAN, F. The Culturally Deprived Child. New York: Harper, 1962. Pp. 140.

ROBACK, A. A. History of Psychology and Psychiatry. New York: Philosophical Library, 1961. Pp. 422.

RODRIGUEZ, L. J. God Bless the Devil: The Key to the Liberation of Psychiatry. New York: Bookman Associates, 1962. Pp. 256.

ROESSLER, R., & GREENFIELD, N. S., *Eds.* Physiological Correlates of Psychological Disorder. Madison, Wisconsin: Univ. Wisconsin Press, 1962. Pp. 281.

ROGERS, C. A., & FRANTZ, C. Racial Themes in Southern Rhodesia: The Attitudes and Behavior of the White Population. New Haven: Yale Univ. Press, 1962. Pp. 427.

ROSE, A. M. Human Behavior and Social Processes. Boston: Houghton Mifflin, 1962. Pp. 680.

ROSENBLITH, J. F., & ALLINSMITH, W. The Causes of Behavior: Readings in Child Development and Educational Psychology. Boston: Allyn & Bacon, 1962. Pp. 514.

ROUCEK, J. S., *Ed.* The Unusual Child. New York: Philosophical Library, 1962. Pp. 293.

RUESCH, J. Therapeutic Communication. New York: W. W. Norton, 1961. Pp. 340.

RUNES, D. D. The Art of Thinking. New York: Philosophical Library, 1961. Pp. 90.

RUSSELL, W. R., & ESPIR, M. L. E. Traumatic Aphasia: A Study of Aphasia in War Wounds of the Brain. New York: Oxford Univ. Press, 1961. Pp. 177.

SALZMAN, L., & MASSERMAN, J. H., *Eds.* Modern Concepts of Psychoanalysis. New York: Philosophical Library, 1962. Pp. 210.

SANFORD, N., *Ed.* The American College: A Psychological and Social Interpretation of the Higher Learning. New York: John Wiley, 1962. Pp. 1084.

SAPORTA, S., *Ed.* Psycholinguistics: A Book of Readings. New York: Holt, Rinehart & Winston, 1961. Pp. 551.

SARTAIN, A. Q., NORTH, A. J., STRANGE, J. R., & CHAPMAN, H. M. Psychology: Understanding Human Behavior. New York: McGraw-Hill, 1962. Pp. 432.

SAVAGE, I. R. Bibliography of Nonparametric Statistics. Cambridge, Mass.: Harvard Univ. Press, 1962. Pp. 284.

SCHLAIFER, R. Statistics for Business Decisions. New York: McGraw-Hill, 1961. Pp. 382.

SCHONELL, F. J. The Psychology and Teaching of Reading. New York: Philosophical Library, 1961. Pp. 295.

SCOTT, W. A., & WERTHEIMER, M. Introduction to Psychological Research. New York: John Wiley & Sons, 1962. Pp. 445.

SELLS, S. B. Essentials of Psychology. New York: Ronald Press, 1962. Pp. 513.

SHEER, D. D., *Ed.* Electrical Stimulation of the Brain. Austin, Tex.: Univ. Texas Press, 1961. Pp. 640.

SINAIKO, H. W., *Ed.* Selected Papers on Human Factors in the Design and Use of Control Systems. New York: Dover Publications, 1961. Pp. 405.

SNIDER, R. S., & LEE, J. C. A Stereotaxic Atlas of the Monkey Brain. Chicago: Univ. Chicago Press, 1961. Pp. 130.

SNIDER, R. S., & NIEMER, W. T. A Stereotaxic Atlas of the Cat Brain. Chicago: Univ. Chicago Press, 1961. Pp. 132.

STONE, L. The Psychoanalytic Situation: An Examination of Its Development and Essential Nature. New York: International Univs. Press, 1961. Pp. 160.

SWABEY, M. C. Comic Laughter: A Philosophical Essay. New Haven, Conn.: Yale Univ. Press, 1961. Pp. 251.

SWAIM, L. T. Arthritis, Medicine and the Spiritual Laws: The Power Beyond Science. Philadelphia: Chilton Books, 1962. Pp. 139.

THORPE, L. P. Child Psychology and Development: Third Edition. New York: Ronald Press, 1962. Pp. 628.

TOMAN, W. Family Constellation: Theory and Practice of a Psychological Game. New York: Springer Publishing, 1961. Pp. 248.

Townsend, E. A., & Burke, P. J. Learning for Teachers. New York: Macmillan, 1962. Pp. 313.

Van Dalen, D. B. Understanding Educational Research: An Introduction. New York: McGraw-Hill, 1962. Pp. 432.

Wahlke, J. C., Eulau, H., Buchanan, W., & Ferguson, L. C. The Legislative System: Explorations in Legislative Behavior. New York: John Wiley & Sons, 1962. Pp. 517.

Walker, E. L., & Heyns, R. W. An Anatomy for Conformity. Englewood Cliffs, N.J.: Prentice-Hall, 1962. Pp. 103.

Webb, W. B., *Ed.* The Profession of Psychology. New York: Holt, Rinehart & Winston, 1962. Pp. 291.

Weinstein, E. A. Cultural Aspects of Delusion: A Psychiatric Study of the Virgin Islands. New York: Free Press of Glencoe, 1962. Pp. 215.

Wells, G. R. Sense and Nonsense in Religion. New York: Vantage Press, 1962. Pp. 182.

Winn, R. B. Psychotherapy in the Soviet Union. New York: Philosophical Library, 1961. Pp. 207.

Wittenberg, R. Common Sense about Psychoanalysis. New York: Doubleday, 1962. Pp. 216.

Yacorzynski, G. K., Atkinson, A. J., Cohen, J., & Shufflebarger, F. G. Investigation of Carbon Dioxide Therapy. Springfield, Ill.: Charles C Thomas, 1961. Pp. 313.

Journal of Genetic Psychology

CARL MURCHISON

Quarterly, published in March, June, September, and December. Devoted to child behavior, animal behavior, and the problems of aging. Manuscripts may be sent to any member of the Editorial Board, or may be sent directly to the general editorial office. All subscriptions and business communications should be sent directly to The Journal Press. Two volumes annually. Per annum, $20.00; per volume, $15.00; single numbers, $7.50. Complete sets from 1891 at $15.00 per volume, plus transportation.

Journal of General Psychology

CARL MURCHISON

Quarterly, published in January, April, July, and October. Devoted primarily to experimental, theoretical, clinical, and historical psychology. Manuscripts may be sent to any member of the Editorial Board, or may be sent directly to the general editorial office. All subscriptions and business communications should be sent directly to The Journal Press. Two volumes annually. Per annum, $20.00; per volume, $15.00; single numbers, $7.50. Complete sets from 1927 at $15.00 per volume, plus transportation.

Journal of Social Psychology

CARL MURCHISON

Bimonthly, beginning with February. National, group, cultural, racial, and differential psychology. Manuscripts may be sent to any member of the Editorial Board, or may be sent directly to the general editorial office. All subscriptions and business communications should be sent directly to The Journal Press. Bimonthly, three volumes per year; per annum, $30.00; per volume, $15.00; single numbers, $7.50. First number is dated February, 1930. Complete sets from 1930 at $15.00 per volume, plus transportation.

Each author will receive 100 unbound reprints gratis. Additional reprints may be purchased at a nominal cost when the author returns page-proof.

THE JOURNAL PRESS
2 Commercial Street
Provincetown, Massachusetts
U. S. A.

Club Rate For Five International Psychological Journals

	PER ANNUM
THE JOURNAL OF GENETIC PSYCHOLOGY (Quarterly, two volumes per year)	$20.00
GENETIC PSYCHOLOGY MONOGRAPHS (Quarterly, two volumes per year)	$20.00
THE JOURNAL OF GENERAL PSYCHOLOGY (Quarterly, two volumes per year)	$20.00
THE JOURNAL OF SOCIAL PSYCHOLOGY (Bimonthly, three volumes per year)	$30.00
THE JOURNAL OF PSYCHOLOGY (Quarterly, two volumes per year)	$20.00
TOTAL	$110.00
TEACHERS AND STUDENTS EDITION, *Restricted Sale*	$30.00

The *Teachers and Students Edition* is open to any individual psychologist, teacher, student, or physician but requires an agreement that the edition will not be offered for sale till after five years from publication and an agreement that the edition will not be substituted for an institutional subscription.

The *"Small-Library" Edition* is discontinued.

THE JOURNAL PRESS
2 Commercial Street
Provincetown, Massachusetts
U. S. A.

Genetic Psychology Monographs

CARL MURCHISON

Quarterly: February, May, August, November. Two volumes per year. Child behavior, animal behavior, and the problems of aging. Each number one or more complete researches. Manuscripts may be sent to any member of the Editorial Board, or may be sent directly to the general editorial office. All subscriptions and business communications should be sent directly to The Journal Press. Two volumes annually. Per annum, $20.00; per volume, $15.00; single numbers, $7.50. Complete sets from 1926 at $15.00 per volume, plus transportation.

NOTICE. Once more we offer free publication for certain selected monographs. Authors will be charged for cuts and expensive tables, but there will be no page charge for the first 50 pages. For all pages above 50 there will be a charge of $10.00 per page. Two hundred reprints of each monograph will be supplied free of charge, but there will be nominal charges for such things as vitas, special covers, or special title pages.

Genetic Psychology Monographs *(continued)*

VOLUME 1—1926

1. Performance tests for children of pre-school age—R. Stutsman
2. An experimental study of the eidetic type—H. Klüver
3 & 4. A study of natio-racial mental differences—N. D. M. Hirsch
5. A psychological study of juvenile delinquency by group methods—J. W. Bridges and K. M. B. Bridges
6. The influence of puberty praecox on mental growth—A. Gesell

VOLUME 2—1927

1 & 2. The mind of a gorilla—R. M. Yerkes
3. The role of eye-muscles in the expression of the emotions—K. Dunlap
4. Family similarities in mental-test abilities—R. H. Willoughby
5. Coördination in the locomotion of infants—L. H. Burnside
6. The mind of a gorilla: Part II. Mental development—R. M. Yerkes

VOLUME 3—January-June, 1928

1. An experimental study of the olfactory sensitivity of the white rat—J. R. Liggett
2. A photographic study of eye movements in reading formulae—M. A. Tinker
3. An experimental study of the East Kentucky mountaineers—N. D. M. Hirsch
4. Responses of foetal guinea pigs prematurely delivered—G. T. Avery
5. Objective differentiation between three groups in education (teachers, research workers, and administration)—M. B. Jensen
6. The effect of segregation on the sex behavior of the white rat as measured by the obstruction method—M. Jenkins

VOLUME 4—July-December, 1928

1. Observation and training in the fundamental habits in young children—E. A. Bott, W. E. Blatz, N. Chant, and H. Bott
2 & 3. Determination of a content of the course in literature of a suitable difficulty for junior and senior high school students—M. C. Burch
4 & 5. Methods for diagnosis and treatment of cases of reading disability—M. Monroe (*foreword by Samuel T. Orten*)
6. The relative effectiveness of lecture and individual reading as methods of college teaching—E. B. Greene

VOLUME 5—January-June, 1929

1. The age factor in animal learning: I. Rats in the problem box and the maze—C. P. Stone
2. The effect of delayed incentive on the hunger drive in the white rat—E. L. Hamilton
3. Which hand is the eye of the blind?—J. M. Smith
4. The effect of attitude on free word association-time—A. G. Ekdahl
5. The localization of tactual space: A study of average and constant errors under different types of localization—L. E. Cole
6. The effect of gonadectomy, vasotomy, and injection of placental and orchic extracts on the sex behavior of the white rat—H. Thomson

VOLUME 6—July-December, 1929

1. Learning and growth in identical infant twins: An experimental study by the method of co-twin control—A. Gesell and H. W. Nissen
2. The age factor in animal learning: II. Rats in a multiple light discrimination box and a difficult maze—C. P. Stone
3. The acquisition and interference of motor habits in young children—E. McGinnis
4. A vocational and socio-educational survey of graduates and non-graduates of small high schools of New England—A. D. Mueller
5 & 6. A study of the smiling and laughing of infants in the first year of life—R. W. Washburn

VOLUME 7—January-June, 1930

1. Tensions and emotional factors in reaction—E. Duffy
2. Teacher influence on class achievement: A study of the relationship of estimated teaching ability to pupil achievement in reading and arithmetic—H. R. Taylor
3 & 4. A study of the effect of inverted retinal stimulation upon spatially coördinated behavior—P. H. Ewert
5. Mental development of children with lesion of the central nervous system—E. Lord
6. An experimental study upon three hundred school children over a six-year period—N. D. M. Hirsch

VOLUME 8—July-December, 1930

1. The amount and nature of activities of newborn infants under constant external stimulating conditions during the first ten days of life—O. C. Irwin
2. Race and social differences in performance tests—S. D. Porteus, D. M. Dewey, and R. G. Bernreuter
3. Language and growth: The relative efficacy of early and deferred vocabulary training—L. C. Strayer
4. Eye-movements and optic nystagmus in early infancy—J. M. McGinnis
5 & 6. Reactions of kindergarten, first-, and second-grade children to constructive play materials—L. Farwell

VOLUME 9—January-June, 1931

1 & 2. The status of the first-born with a special reference to intelligence—H. H. Hsiao
3 & 4. An experimental study of bright, average and dull children at the four-year mental level—H. P. Davidson
5. An historical, critical, and experimental study of the Seashore-Kwalwasser test battery—P. R. Farnsworth
6. A comparison of difficulty and improvement in the learning of bright and dull children in reproducing a descriptive selection—F. T. Wilson

VOLUME 10—July-December, 1931

1. A comparative study of a group of southern white and negro infants—M. B. McGraw
2 & 3. An experimental study of prehension in infants by means of systematic cinema records—H. M. Halverson
4. The limits of learning ability in kittens—A. M. Shuey
5 & 6. The effect of habit interference upon performance in maze learning—O. W. Alm

VOLUME 11—January-June, 1932

1. General factors in transfer of training in the white rat—T. A. Jackson
2. The effect of color on visual apprehension and perception—M. A. Tinker
3. The reliability and validity of maze experiments with white rats—R. Leeper
4. A critical study of two lists of best books for children—F. K. Shuttleworth
5 & 6. Measuring human energy cost in industry: A general guide to the literature—R. M. Page

VOLUME 12—July-December, 1932

1. Family resemblances in verbal and numerical abilities—H. D. Carter
2. The development of fine prehension in infancy—B. M. Castner
3 & 4. The growth of adaptive behavior in infants: An experimental study at seven age levels—H. M. Richardson
5 & 6. Differential reactions to taste and temperature stimuli in newborn infants—K. Jensen

VOLUME 13—January-June, 1933

1. A critique of sublimation in males: A study of forty superior single men—W. S. Taylor
2. A study of the nature, measurement, and determination of hand preference—H. L. Koch, *et al.*
3. The growth and decline of intelligence—H. E. Jones and H. S. Conrad
4. The relation between the complexity of the habit to be acquired and the form of the learning curve in young children—M. L. Mattson
5. Eating habits in relation to personality developments in two-, and three-year-old children: A study of sixty-nine children in two nursery schools—A. A. Eliot
6. Coördinating mechanisms of the spinal cord—O. C. Ingebritsen

Genetic Psychology Monographs *(continued)*

VOLUME 14—July-December, 1933

1. Mental growth during the first three years: A developmental study of sixty-one children by repeated tests—N. Bayley
2. A study of triplets: including theories of their possible genetic relationships—F. N. Anderson and N. V. Schiedemann
3. The objective measurement of emotional reactions—H. V. Gaskill
4. Development of behavior in the fetal cat—J. D. Coronios
5. A study of certain language development of children in grades four to twelve, inclusive—L. L. LaBrant
6. The effect of early delayed practice in memory and motor performance studied by the method of co-twin control—J. R. Hilgrad

VOLUME 15—January-June, 1934

1. Studies in the psychology of tone and music—P. R. Farnsworth
2. Motor learning of children in equilibrium in relation to nutrition—E. L. Beebe
3. Discrimination limens of pattern and size in the goldfish *Carassius auratus*—J. B. Rowley
4. Limits of learning in the white rat and the guinea pig—B. F. Riess

5 & 6. The limits of learning ability in rhesus monkeys—H. A. Fjeld

VOLUME 16—July-December, 1934

1. A statistical study of ratings on the California behavior inventory for nursery school children—H. S. Conrad
2. An eye-movement study of objective examination questions—A. Frandsen
3. An experimental study of constitutional types—O. Klineberg, S. E. Asch, and H. Block
4. The development of a battery of objective group tests of manual laterality with the results of their application to 1,300 children—W. N. Durost

5 & 6. An experimental study in the prenatal guinea-pig of the origin and development of reflexes and patterns of behavior in relation to the stimulations of specific receptor areas during the period of active fetal life—L. Carmichael

VOLUME 17—January-December, 1935

1. Organization of behavior in the Albino rat—R. L. Thorndike
2. Brightness discrimination in the rhesus monkey—M. P. Crawford
3. The limits of learning ability in cebus monkeys—A. M. Koch
4. Nature-nurture and intelligence—A. M. Leahy
5. On intelligence of epileptic children—E. B. Sullivan and L. Gahagan
6. A study of the play of preschool children by an unobserved observer—D. L. Cockerel

VOLUME 18—January-December, 1936

1. Sex differences in variational tendency—Q. McNemar and L. M. Terman
2. The process of learning to dress among nursery-school children—C. B. Key, M. R. White, A. B. Hieney, M. P. Honzik, and D. Erwin
3. A study of the present social status of a group of adults who, when they were in the elementary schools, were classified as mentally deficient—W. Baller
4. The influence of specific experience upon mental organizations—A. Anastasi

5 & 6. Studies in aggressiveness—L. Bender, S. Kriser, and P. Schilder

VOLUME 19—January-December, 1937

1. Psychological bases of self-mutilation—C. Dabrowski
   Masculine temperament and secondary sex characteristics: A study of the relationship between psychological and physical measures of masculinity—H. Gilkinson
2. A psychological study of forty unmarried mothers—R. D. Nottingham
   Behavior problems in the children of psychotic and criminal parents—L. Bender
3. Domination and integration in the social behavior of young children in an experimental play situation—H. H. Anderson
4. The sequential patterning of prone progression in the human infant—L. B. Ames

VOLUME 20—January-December, 1938

1. The relationship between characteristics of personality and physique in adolescents—P. S. de Q. Cabot
2. Behavior problems of elementary school: A description and comparative study—I. Young-Masten
   Graphic representation of a man by four-year-old children in nine prescribed drawing situations—P. E. Gridley
3. Differences between two groups of adult criminals—R. S. Tolman
4. A comparative study by means of the Rorschach method of personality development in twenty pairs of identical stimuli—W. E. Gault
   Individual differences in the facial expressive behavior of pre-school children: A study by the time-sampling method—C. Swan

VOLUME 21—January-December, 1939

1. An experimental analysis of "level of aspiration"—R. Gould
2. Some light on the problem of bilingualism as found from a study of the progress in mastery of English among pre-school children of non-American ancestry in Hawaii—M. E. Smith
3. Domination and social integration in the behavior of kindergarten children and teachers—H. H. Anderson
   The capacity of the rhesus and cebus monkey and the gibbon to acquire differential response to complex visual stimuli—W. E. Gault
4. The social-sex development of children—E. H. Campbell

VOLUME 22—January-December, 1940

1. Measuring human relations: An introduction to the study of the interaction of individuals—E. D. Chapple
2. Aggressive behavior in young children and children's attitudes toward aggression—M. D. Fite
3. Student attitudes toward religion—E. Nelson
   The prediction of the outcome-on-furlough of dementia praecox victims—J. S. Jacob
   Significant characteristics of pre-school children as located in Conrad inventory—K. H. Read
4. Learning by children at noon-meal in a nursery school: Ten "good" eaters and ten "poor" eaters—J. B. McKay, E. B. Waring, and P. J. Kruse
   Studies in the interpretation of play: I. Clinical observation of play disruption in young children—E. H. Erikson

VOLUME 23—January-June, 1941

1. An analysis of certain variables in a developmental study of language—F. M. Young
   An analysis of the mental factors of various age groups from nine to sixty—B. Balinsky
2. Factors influencing performance on group and individual tests of intelligence: I. Rate of work—M. W. Bennett
   Individual differences in apperceptive reaction: A study of the response of preschool children to pictures—E. W. Amen

VOLUME 24—July-December, 1941

1. Twins *T* and *C* from infancy to adolescence. A biogenetic study of individual differences by the method of co-twin control—A. Gesell and H. Thompson
   Finger nail-biting: its incipiency, and amelioration—A. L. Billig
   An experimental study of the factors of maturation and practice in the behavioral development of the embryo of the frog, *Rana pipiens*—A. Fromme
2. The Fels child behavior scales—T. W. Richards and M. P. Simons
   Measurement of the size of general English vocabulary through the elementary grades and high school—M. K. Smith
   Stereotypes in the field of musical eminence—P. R. Farnsworth

VOLUME 25—January-June, 1942

1. A study of factors determining family size in a selected professional group—J. C. Flanagan
   A genetic study of geometrical-optical illusions—Sister A. Walters
   Interpretation of behavior-ratings in terms of favorable and unfavorable deviations: A study of scores from the Read-Conrad Behavior Inventory—K. H. Read and H. S. Conrad
2. Are there any innate behavior tendencies?—J. B. Schoolland
   An investigation of the intelligibility of the speech of the deaf—C. V. Hudgins and F. C. Numbers

Genetic Psychology Monographs *(continued)*

VOLUME 26—July-December, 1942

1. The critical frequency limen for visual flicker in children between the ages of 6 and 18—V. L. MILLER
Some factors determining handedness in the white rat—K. L. WENTWORTH
2. Motivation and behavior—E. FRENKEL-BRUNSWIK

VOLUME 27—January-June, 1943

1. Comparison of children's personality traits, attitudes, and intelligence with parental occupation—N. R. MADDY
2. A comparative study of mental functioning patterns of problem and non-problem children seven, eight, and nine years of age—M. L. PIGNATELLI

VOLUME 28—July-December, 1943

1. Separation anxiety in young children: A study of hospital cases—H. EDELSTON
2. Correlates of vocational preferences—W. A. BRADLEY, JR.

VOLUME 29—January-June, 1944

1. Mental changes after bilateral prefrontal lobotomy—S. D. PORTEUS AND R. D. KEPNER
2. A twin-controlled experiment on the learning of auxiliary languages—B. PRICE, W. J. KOSTIR, AND W. M. TAYLOR

VOLUME 30—July-December, 1944

1. A method of administering and evaluating the thematic apperception test in group situations—R. M. CLARK
2. A study of anxiety reactions in young children by means of a projective technique—R. TEMPLE AND E. W. AMEN

VOLUME 31—January-June, 1945

1. The evolution of intelligent behavior in rhesus monkeys—B. WEINSTEIN
2. Perceptual behavior of brain-injured, mentally defective children: An experimental study by means of the Rorschach technique—H. WERNER

VOLUME 32—July-December, 1945

1. A clinical study of sentiments: I.—H. A. MURRAY AND C. D. MORGAN
2. A clinical study of sentiments: II.—H. A. MURRAY AND C. D. MORGAN

VOLUME 33—January-June, 1946

1. Interpretation of spontaneous drawings and paintings—T. S. WAEHNER
Preference for sex symbols and their personality correlates—K. FRANCK
2. Outstanding traits in a selected college group—F. L. WELLS AND W. L. WOODS

VOLUME 34—July-December, 1946

1. The relation of emotional adjustment to intellectual function—J. L. DESPERT AND H. O. PIERCE
The smiling response—R. A. SPITZ
2. Finger-painting and personality diagnosis—P. J. NAPOLI

VOLUME 35—January-June, 1947

1. The thematic apperception technique in the study of culture-personality relations—W. E. HENRY
2. A continuation study of anxiety reactions in young children by means of a projective technique—M. DORKEY AND E. W. AMEN
A study of the vocational interest trends of secondary school and college women—A. M. CAWLEY

VOLUME 36—July-December, 1947

1. Maze test validation and psychosurgery—S. D. PORTEUS AND H. N. PETERS
2. Diagnostic implications of Rorschach's Test in case studies of mental defectives—I. JOLLES

VOLUME 37—January-June, 1948

1. The radio daytime serial: A symbolic analysis—W. L. WARNER AND W. E. HENRY
The relation of personality characteristics and response to verbal approval in a learning task—G. L. GRACE
2. The mechanism of vision: XVIII. Effects of destroying the visual "associative areas" of the monkey—K. S. LASHLEY
A study of the relationship between handwriting and personality variables—P. CASTELNUOVA-TEDESCO

VOLUME 38—July-December, 1948

1. Modern language learning: The intensive course as sponsored by the United States Army, and implications for the undergraduate course of study—M. LIND
Conflict: A study of some interactions between appetite and aversion in the white rat—M. A. TOLCOTT
2. A study of certain formal psycho-social aspects of fantasy production in schizophrenia as revealed by performance on the Make a Picture Story (Maps) Test—E. S. SHNEIDMAN
A study of the transmission of authority in the family—H. L. INGERSOLL

VOLUME 39—January-June, 1949

1. A study of the psychoanalytic theory of psychosexual development—G. S. BLUM
The assessment of parental attitudes in relation to child adjustment—E. J. SHOBEN, JR.
2. Qualitative differences in the vocabulary responses of normals and abnormals—H. FEIFEL
The relative effectiveness of motion and still pictures as stimuli for eliciting fantasy stories about adolescent-parent relationship—P. E. EISERER
The organization of heredity maze-brightness and maze-dullness—L. V. SEARLE

VOLUME 40—July-December, 1949

1. An experimental study of what young school children expect from their teachers—B. BIBER AND C. LEWIS
A study of the relative effects of age and of test difficulty upon factor patterns—H. A. CURTIS
A projective experiment using incomplete stories with multiple choice endings—J. K. SEATON
2. Effects of sex role and social status on the early adolescent personality—E. MILNER
Social perceptions and attitudes of children—M. RADKE, H. TRAGER, AND H. DAVIS

VOLUME 41—January-June, 1950

1. Some psychological and educational aspects of pediatric practice: A study of well-baby clinics—L. H. BLUM
One-trial learning in the domestic rat—B. B. HUDSON
An introduction to the principles of scientific psychoanalysis—A. ELLIS
2. Awareness of racial differences by preschool children in Hawaii—D. V. SPRINGER
Children's evaluation of teacher-approved and teacher-disapproved behavior—S. L. WITRYOL
The relationship between level of vocational aspiration and certain personal data—J. STUBBINS

VOLUME 42—July-December, 1950

1. Personality patterns of suicidal mental hospital patients—N. L. FARBEROW
Sex-role identification in young children in two diverse social groups—M. RABBAN
2. A study of the influence of the social field on individual behavior: As revealed in the expression of hostility and warmth by neurotics and paranoid schizophrenics in discussion group situations—D. SHAPIRO
An experimental study of avoidance—R. F. HEFFERLINE

VOLUME 43—January-June, 1951

1. A study of copying ability in children—E. A. TOWNSEND
Prestige motivation of gifted children—D. P. AUSUBEL
2. A psychological study of physical scientists—A. ROE

VOLUME 44—July-December, 1951

1. The organization of hostility controls in various personality structures—S. FISHER AND E. HINDS
Children and radio: A study of listeners and non-listeners to various types of radio programs in terms of selected ability, attitude, and behavior measures—E. A. RICCIUTI
2. Quantitative expression in young children—W. E. MARTIN
The use of magnetic devices in the collection and analysis of the preverbal utterances of an infant—A. W. LYNIP

VOLUME 45—January-June, 1952

1. Japanese American personality and acculturation—W. CAUDILL
2. A statistical study of the Freudian theory of levels of psychosexual development—C. A. BARNES
Personality characteristics of selected disability groups—D. N. WIENER

Genetic Psychology Monographs *(continued)*

VOLUME 46—July-December, 1952

1. The relationship of social status, intelligence, and sex of 10- and 11-year-old children to an awareness of poverty—F. J. Estvan
   An empirical study of the castration and Oedipus complexes—S. Friedman
2. The relationship between projective test scoring categories and activity preferences—M. M. Schwartz
   A comparison of formal and content factors in the diagnostic testing of schizophrenia—M. Sherman

VOLUME 47—January-June, 1953

1. Ability and accomplishment of persons earlier judged mentally deficient—D. C. Charles
   Variations in the consistency of the behavioral meaning of personality test scores—M. Kornreich
   Some child-rearing antecedents of aggression and dependency in young children—R. R. Sears, *et al.*
   Symptom correlates for descriptive diagnosis—J. R. Wittenborn, *et al.*

VOLUME 48—July-December, 1953

1. Age and mental abilities: A longitudinal study—W. A. Owens, Jr.
   The development of a personality questionnaire for drinkers—P. J. Hampton
   Personality and physical disease: A test of the Dunbar hypothesis applied to diabetes mellitus and rheumatic fever—D. H. Crowell
2. Socio-economic contrasts in children's peer culture prestige values—B. Pope
   A critical review of the stability of social acceptability scores obtained with the partial-rank-order and the paired-comparison scales—S. A. Witryol and G. G. Thompson
   A study of the effects of color in Rorschach response—G. G. Brody

VOLUME 49—January-June, 1954

1. Factors underlying major reading disabilities at the college level—J. A. Holmes
   Parent behavior toward first and second children—J. K. Lasko
2. Social-status and intelligence: An experimental study of certain cultural determinants of measured intelligence—E. A. Haggard
   Certain determinants and correlates of authoritarianism—S. Siegel
   Personalities in faces: I. An experiment in social perceiving—P. F. Secord, W. F. Dukes and W. Bevan

VOLUME 50—July-December, 1954

1. A study of the relationship between play patterns and anxiety in young children—E. W. Amen and N. Renison
   Operational explorations of the conceptual self system and of the interaction between frames of reference—M. Edelson and A. E. Jones
   Problem solving: A statistical description of some relationships between organismic factors and selected response measures—N. A. Fattu, E. Kapos and E. V. Mech
2. The relation of cortical potentials to perceptual functions—C. Chyatte
   The import for clinical psychology of the use of tests devised from theories about infantile sexuality and adult character—D. W. Miles
   Measuring personality in developmental terms: The P.P.S.—M. H. Krout and J. K. Tabin

VOLUME 51—January-June, 1955

1. Some relations between techniques of feeding and training during infancy and certain behavior in childhood—A. Bernstein
   The expression of personality in drawings and paintings—L. H. Stewart
2. Negative stereotypes concerning Americans among American-born children receiving various types of minority-group education—J. A. Fishman
   The Lincoln-Oseretsky motor development scale—W. Sloan

VOLUME 52—July-December, 1955

1. Some personality correlates of sex, sibling position, and sex of sibling among five- and six-year-old children—H. L. Koch
   A quantitative Rorschach assessment of maladjustment and rigidity in acculturating Japanese Americans—G. Devos
   Measurement of authoritarianism and its relation to teachers' classroom behavior—H. M. McGee
2. The formal aspects of schizophrenic verbal communication—B. Mirin
   A study in an aspect of concept formation with subnormal, average, and superior adolescents—H. N. Hoffman
   Traumatic avoidance learning: Acquisition and extinction in dogs deprived of normal peripheral autonomic function—L. C. Wynne and R. L. Solomon

VOLUME 53—January-June, 1956

1. As the psychiatric aide sees his work and problems—F. L. Wells, M. Greenblatt and R. W. Hyde
   An investigation of avoidance, anxiety, and escape behavior in human subjects as measured by action potentials in muscle—J. D. Brothers
   Spread of effect: A critical review—M. H. Marx
2. Stress, fantasy, and schizophrenia: A study of the adaptive processes—O. J. B. Kerner
   The attitude structure of the individual: A Q-study of the educational attitudes of professors and laymen—F. N. Kerlinger

VOLUME 54—July-December, 1956

1. A study of the personality differences between middle and lower class adolescents: The Szondi Test in culture-personality research—L. Rainwater
   The assessment of parental identification—S. W. Gray and R. Klaus
2. The influence of social context on impulse and control tendencies in preadolescents—G. H. Zuk
   Tender-mindedness versus tough-mindedness in psychology: A reexamination—H. Winthrop
   A method for the comparison of groups: A study in thematic apperception—L. C. Shaw and W. E. Henry

VOLUME 55—January-June, 1957

1. Academic performance and personality adjustments of highly intelligent college students—B. M. Horrall
   The use of the Vineland Social Maturity Scale in the planning of an educational program for non-institutionalized low-grade mentally deficient children—M. G. Gottsegen
2. The structure and origin of the anal character—H. Beloff
   Free expression of adolescents' interests—M. Amatora
   The role of mass media and the effect of aggressive film content upon children's aggressive responses and identification choices—R. S. Albert
   Interest in persons as an aspect of sex difference in the early years—E. W. Goodenough

VOLUME 56—July-December, 1957

1. Some stable response determinants of perception, thinking, and learning: A study based on the analysis of a single test—M. L. Simmel and S. Counts
   Potentials of age: An exploratory field study—S. L. Pressey
2. Tactile communication—L. K. Frank
   The use of a filmed puppet show as a group projective technique for children—M. R. Haworth
   The social competence of middle-aged people—R. J. Havighurst

VOLUME 57—January-June, 1958

1. Psychological and cultural problems in mental subnormality: A review of research—S. B. Sarason and T. Gladwin
2. Developmental aspects of discrimination in relation to adjustment—P. London
   Muscular tension as a response to psychological stress in rheumatoid arthritis and peptic ulcer—J. A. Southworth
   Frustration: Theory and experiment—R. Lawson and M. H. Marx

VOLUME 58—July-December, 1958

1. Emotional aspects of political behavior: The woman voter—E. M. Bennett and H. W. Goodwin
   The accuracy of self estimate: A measure of self-concept reality—R. M. Brandt
   Personality factors in social mobility: A study of occupationally mobile businessmen—J. C. Abegglen
2. Interaction between authoritarian and nonauthoritarian principals and teachers—P. Lambert
   Some factors related to the choice-status of ninety eighth-grade children in a school society—D. Elkins
   Some relationships between fantasy and self-report behavior—R. G. Calogeras

Genetic Psychology Monographs *(continued)*

THE JOURNAL PRESS
2 Commercial Street
Provincetown, Massachusetts
U. S. A.

$20.00 per year
$15.00 per volume
Single Numbers $7.50

QUARTERLY
Two volumes per year

June, 1963
Volume 102, Second Half

Founded by G. Stanley Hall in 1891, reorganized by Carl Murchison in 1925

THE JOURNAL OF GENETIC PSYCHOLOGY

Child Behavior, Animal Behavior, and Problems of Aging

If this space should be unstamped, this is the regular library edition. But if this space is stamped with a designating title, this is a special edition, sold

under the restrictions of a liberal contract, and may not be resold for a period of five years from the date of publication.

JUNE, 1963

(Manuscripts are printed in the order of final acceptance)

Copyright, 1963, by The Journal Press
Provincetown, Massachusetts, U. S. A.

Entered as second-class matter April 3, 1937, at the post-office at Provincetown, Mass., under the Act of March 3, 1879
Second-class postage paid at Provincetown, Mass.

The Journal of Genetic Psychology, 1963, **102**, 175-188.

THE STATUS OF INTELLIGENCE IN THE AGING*

Department of Education-Psychology, Kentucky State College

James Latimer

A. The Attitude and Interests of the Aging

Because attitudes and interests of people as they grow older may significantly determine the direction, or maintenance of intelligence, it is necessary to consider the influence of these factors on the intelligence of the aging. In the opinion of Lorge, adults learn much less than they might, partly because of their attitude of underestimating their ability, as well as their fearful reaction to the criticism concerning their attempted performance. "Failure to keep on learning," Lorge asserts, "may affect performance more than power itself" (12, p. 7).

Concerning interest, it was proven especially by Lorge's experimental data that it can be taught and learned. In one of his experiments, he taught adults to like cod liver oil, stand in uncomfortable positions, and to speak Russian. This authority directs our attention to the fact that disliking certain tasks may cause persons to fail to acquire necessary goals in education. We see the relationship between this idea and Thorndike's famous laws of learning. Lorge declares, "People over 40 learned almost as well as younger adults" (12, p. 9).

Thorndike emphasizes the fact that the interests most needed as a basis for adult education, such as in books, current events, people, making new acquaintances, and travel do not dry up and vanish. These interests are considered as consistently motivating the learning of adults (12, p. 8). Pressey, however, suggests that the aging do have a more restricted social life, read less, attend fewer movies, and possibly choose their friends, books, and movies to conform to their own bias, etc. (17, p. 496). Howbeit, other interests in affairs of the world, as well as in religious programs, music, drama, and sports increase (17, p. 405). Strong records that interests change rapidly from those held at 15 to those held at 25 years and then shift in the reverse direction much more slowly from 25 years to 55 years of age (12, p. 8).

"The evidence about attitude stability in older persons does suggest that

* Received in the Editorial Office on January 23, 1963 and given prior publication in accordance with our policy regarding manuscripts on the subject of aging.

some of the so-called conservatism of aging is indicative of the crystalization of values learned in the early years." Lorge further predicates, "The values and concepts that were considered radical in one's youth may be conservative for the following generation" (12, p. 8). In other words, he points to the pertinent fact that external life is changing around these people. Not all the changes are internal. Aging brings not so much resistance to change as stabilization of values, interests, and concepts (12, p. 8).

This viewpoint is supported by Pressey, in attesting that aging individuals are influenced not so much by biological decline as by social and psychological attitudes. He stresses the importance of people "maintaining an active participation in living, and exposing themselves to varied stimulation, and challenges with the passing years." He likewise proposes that society should reduce some of its biases as this would mitigate toward eliminating some of the negative attitudes that threaten adult years (17, p. 500). "Already threatened and insecure because of organic and cultural losses," he affirms, "new experiences, demands and challenges are likely to threaten older people still more with the result that they may cling to the established ways of behaving and protect themselves by not venturing forth" (17, p. 309).

Pressey implies that new standards are used to estimate people who were never exposed to the new values. Consequently, they behave in accordance with the way they were educated to think and to act.

> The frequently observed ability of old people to recall in detail events of years gone by, and their inability to recall immediate events may be explained in terms of current frustration and resulting regression. Increasing insecurity resulting from increasing threats to status may explain the generally observed rigidity with increasing adult age, which in turn may explain a variety of changes in personal traits with age (17, p. 309).

Lorge extends our thinking with respect to the supposed changes in the personality of the aging. The stresses and strains in aging process may make adjustment more difficult for the individual who had many symptoms either as a child or an adolescent. He concludes that the evidence about personality change with age is still to be produced (12, p. 10). The capacity of the aged to ignore stimuli as a means of self-protection has been viewed as an active and deliberate process. Instead of being a weakness this narrowing of interest is represented as an asset (25, p. 311).

B. Learning and Intelligence in Aging

The notion that further learning, or intelligence, should not be expected of the aging population, or that the ability to learn steadily declines with the

advance in years has been studied, and some conclusive evidence to reverse this assumption follows. In the test given to 641 part-time students ranging from 16 to 70, vocabulary was found to increase with age, and reading ability showed no decrease in this group who were trying to keep up mental ability. "To keep on learning," Pressey believes, "may keep ability limber and maintain habits of wide application of the tools that can serve in an enormous number of situations, and those subtle habits which we usually call ideals, attitudes, methods of procedure and the like" (17, p. 107).

When learning is measured in terms of its level, or quality or goodness, in the opinion of Lorge, then ability as power is more likely to be appraised, and when it is measured in terms of goodness rather than sheer quickness (as in the instance of the experiment in learning to write the unpracticed hand), the learning curve does not show decline for successive age groups (12, p. 2).

It is proposed that the nurture-nature theorists of a quarter of a century ago minimized the importance of nurture, because of their ignorance of methods of testing. The effects of radio, extension of education, travel and general mental horizons were too vast to be included in experimental designs; consequently, intimate factors which emerge from the longitudinal records were missed. Pressey further decries the fact that "studies of great men have been unduly dominated by concepts of constitutional genius, or special pathology (17, p. 160).

Lorge is definite in asserting that "since there is a positive correlation between schooling and intelligence test scores, it must follow that the older members of the population are at the same disadvantage, not only because of their remoteness from schooling, but also because they have had less of it" (12, p. 5).

Truddenham, collaborating with Lorge, indicates the difference in results of his tests of World War II veterans who made a median score of 104, and the median score of the World War I draftees which was 62. The median for the 1940-45 soldiers was at the 88th percentile of the 1917-18 distribution, and he interprets the difference in scores as being indicative of the amount of education the two groups of soldiers had received. He concludes that the present population is superior in mental test performance to the population of a generation ago, and that a large proportion of this superiority is a consequence of more and better education for more people (12, p. 5).

In his discussion, regarding the misconception which has occurred by confounding intelligence with education, Pressey sides with Lorge and Truddenham. He agrees that the findings of 1930's when older adults tested distinctly lower was a true picture of their lower literacy at that time. He

contends that "the term literacy clearly implies that such ability can be increased in the general population by education and really means that the reader may in a very practical sense make himself more intelligent (17, p. 637). He asks, "Is not the literacy needed at 20 somewhat different from that needed at 40, or 60, or 80?" (17, p. 637).

If we examine statistics, critically, as Lorge did, we find that they support the argument in favor of the position that it is often a lack of education, rather than a decline of intelligence that is evident in the performance of the aging. The national census of 1950 shows that the median years of schooling completed for persons in the age range 55 to 64 was 8.4; among these 65 years and over it was 8.2. On the basis of these figures Lorge concludes, ". . . it is obvious that the relatively limited schooling of the older adults may result in an over-generalization about intelligence which has less to do with mental ability as such than the diminishing educational opportunities afforded in childhood and youth" (12, p. 5).

The following figures concern the literacy of a sample of the population who were enrolled in certain types of group adult education in 1957.

Functionally illiterate	9,116,000
With 8th grade education	20,567,000
With only high school education	30,710,000

These figures are quoted because of representing a total of over sixty million with only high schooling, or less than that (11, p. 260).

Another set of figures supplied below shows the erroneous deductions about the decline of intelligence of the aging population. We can contrast 1890, when seven per cent or in figures 387,813, only, of the population of secondary school age were in secondary schools, with 1950 when 75 per cent or 6,427,042 were in attendance. Pressey asks, satirically, "Is it any wonder that in testing the aging population that they show a decline . . . of an education that they never received?" (17, p. 166).

C. Ability as Related to the Environment and Personality of the Aging

The Department of Labor indicated it takes the view that ability is ageless and this attitude is based on the performance of the nation's labor force. Statements are made to the effect that forty plus workers comprise over 40 per cent of the nation's workers; and that most employers reported the performance of individuals past 40 in highly complimentary terms (2, p. 28).

Pressey *et al.* consider abilities as demonstrable competencies of various types which are of wide usefulness, and they think also that these competencies are the result of each organism's growth in its own environment. They quote Wechsler to the effect that general physical reduction in reaction speed caused performers to fail to reach, in the time allowed, tasks that could have been solved by their ability. The curtailment in performance is explained by the fact that intelligence cannot be equated with intellectual ability, but must be regarded as a manifestation of the personality as a whole (17, p. 114).

The basic assumption of Pressey's contention is that there is a relationship between socioeconomic status and ability, and especially the adult abilities which are portrayed as increasingly to be more related to socioeconomic status, the longer they live with that status. "Very limited rural, or poverty, stricken environments might be expected to continue the curves" (17, p. 110). Sundry studies have shown the inadequacy of conventional tests because of the emphasis on language, for measurement of the abilities of persons in a different culture. The substantial weight of most tests is in favor of the middle, and upper, socioeconomic classes (17, p. 111).

Watson reminds us that personality and intelligence are not synonymous. He calls attention to the narrowing methods of studying the aged: "What happens to Sheldon's cerebrotonics, somatotonics, and viserotonics, when age takes its toll? What happens to the Oedipus drama in the aged? The Gestalten of many personality traits must be remembered in studying the aging process" (25, p. 311). In line with Watson's thinking, Pressey attests that dimentia are not simply, or primarily, a loss of reason, but rather diseases of the entire personality, because the "irrationality involves a variety of emotional, sensory, and attitudinal, as well as more narrowly intellectual phenomena" (17, p. 158).

D. Measuring Intelligence in the Aging

A distinction between the slowing down process accompanying aging and the decline in ability, or between the use of the terms speed, and ability is drawn. Lorge argues that many individuals, especially in the older age range, either because of psychological slowing down in personal tempo, or because of time limits, may underestimate their ability (12, p. 4).

Dissenting from the bulk of evidence to the contrary, Shock asserts that there can be no doubt that the average scores attained on intelligence tests diminish with increasing age, with the decline in average scores commencing in the twenties and continuing at an increasing rate up to the age of 60.

However, he concedes that the extent of the nature of the decline in performance beyond the age of 60 is still uncertain; since adequate samples of adults in this age range have not been systematically tested. He supports the conclusions of other researchers that the age change in performance varies considerably in different subtests. For instance, the decrement is very small on vocabulary information and similarity test items; in contrast there is a significant decline in performance on numerical computations, common sense, opposites, series completion, picture arrangement, digit symbols, and analogies problems (21, p. 358).

The implications of Shock's study is that no mass decline in performance in all subjects, or abilities, occurs and it points to the fact that whatever decline there is concerns those areas not in active use by the average adult.

Investigators of adult abilities who have used "intelligence" tests have been struck by an apparent decline of test scores after early maturity, on the basis of the largest collection of such data in the United States army investigation, under Professor Yerkes' chairmanship. Yet the investigators hesitated to posit an age-score decline. It was suggested that the phenomenon might be accounted for by factors of differential selection rather than age specifically (15, p. 208).

Miles further reports having scored the item information test, for 30 persons in each decade from 20's to 70's, in which recognition, rather than recall, is required and no problems involving new materials are presented for recognition. The results show that scores, "rise definitely to a peak in the 40's and 50's to fall again to the early maturity level in the 70's" (15, p. 208).

In a study of learning abilities, three groups of 40 individuals, age 12 to 17, 34 to 39, and 60 to 82 were compared with regard to original ability. Two major tasks and three types of verbal learning were employed. We are told that the average performance of the three groups was stated in terms of the degree of deficit of the older learners as a function of the type of learning material. With the verbal learning tasks, the amount of deficit of the aged increased in the following order: paired associates, nonsense material, false products (18, p. 283).

In discussing the significance of testing intelligence by means of vocabulary, Shakow discloses that when the samples are vigorously selected and more closely examined, neither increase, nor decrease, is shown, at least up to sixty when there is some evidence of a decline. He has indicated an important fact that because vocabulary is little affected by increasing separation from formal training, both as to content and setting which comes with age, it

could be used as an adequate device for determining adult intelligence (22, p. 254).

Vincent concluded that the relation between age and decline is linear. However, he expostulates, "The change in performance with age is in part a function of the nature of the ability measured and the type of test employed" (8, p. 137). Brown and Ghiselli report, an increase in arithmetic score of about half a standard deviation from 20 to 50 years of age (8, p. 131). Ghiselli, who used two devices as measures of intellectual ability, Analysis of Relationship, and Self-Descriptive Inventory, deduces that there is no change in average score during the span of years from 20 to 60. He further states that the ability of older persons is equal to that of younger ones. However, with increasing age there is some decrease in variability. Proportionately, fewer older persons make either higher or lower scores than do younger persons. Older persons, therefore, are more like each other than are younger persons (8, p. 137).

On the basis of his studies, Ghiselli refutes the notion of a general reduction in intelligence with age which is so uniformly reported in the literature. He asserts that this belief does not hold with all individuals nor with all devices for measuring intelligence. He agrees with Lorge in stating that when the psychological functions measured are very high mental processes, when no pressure of time is present and the persons involved are superior adults, there is no change in ability from maturity to 60 years of age. (8, p. 137). The implications from these conclusions are far-reaching because they establish a relationship, which is often overlooked, between the imperfect methods employed generally in testing the intelligence of the aging population and the fallacious conclusions of many studies.

On neither of his tests that were administered to 628 and 795 individuals respectively, ranging from 20 to 65 who had completed at least one year of college did Ghiselli find a downward trend in scores with increasing age. No relationship was manifest between age and intellectual ability in this study (8, p. 141).

Raven has asserted that a clear distinction has been made between a person's capacity to reason by analogy, and his ability to recall information; and the two components of intelligence have been assessed separately. His graph I shows that by 14 a child has reached his maximum in trainability and that after the age of 30 a person's ability to understand a new method of thinking, employ new methods of working, and adjust to a new environment "steadily decreases:" an exception is illustrated in graph II, however, in discussing people who are above the average in ability, he claims that

after the age of ten there is also an increase above the rate at which ability would normally increase. However, even up to the age of 60 there is a slight increase in the test scores for people of superior ability, etc. (19, p. 16-17).

One of the absurdities of our generalization about intelligence, in Pressey's opinion, is that we are comparing factors that are not comparable. We compare intelligence that we do not know with emotions in the hope that one variable that we do not understand will give us understanding of the other which is also in the realm of our ignorance (17, p. 131).

E. Does Intelligence Decline?

Berowitz found that resistance to decline is characteristic of change with age on all subtests of the Wechsler-Bellevue. He attests that it may probably be found in the measurement of all psychological function that decrease in efficiency with increasing age . . . decrease is greater in 20 years preceding age 60 than 20 following. The same results are obtained in comparing 15 years after (3, p. 74). This study could be contrasted with one made by Demming *et al.* "The results on tests that were given indigenous to adult life show the middle aged and older did substantially better than the young adults." They reiterate some of the already discussed problems of testing the aged, and the following questions: "Does intelligence decline? Did we test prior to the senile state? Are we testing with tests indigenous to young populations?" (17, p. 112-113).

Bromley disagrees with Lehman's ideals and states:

> Although loss of intellectual efficiency with age does not account for the decline in quality, or quantity of creativity output, it does account for the major part, hence contrary to Lehman's arguments the decline of adult intelligence is a potential factor in the reduction with age of creative intellectual output (5, p. 80).

Bromley's conclusions are materially refuted by Owens, in one of the very few longitudinal studies in this area. Owen's problem concerned the age changes in mental organization after an interval of 31 years. He examined 127 male freshmen at Iowa State College, using the Army Alpha Examination Form 6. Each matrix of subtests intercorrelated was factored by the method of principal components and the two sections were compared. He concluded that "there was a large amount of "G" present in the test results of the present subjects at mean age of 51 (1950) than at mean age of 19 (1919), (16, p. 296-302).

The prediction is ventured by Pressey that improved testing will show greatest total score around 30 (as does the 1955 Wechsler even though

it is believed to be too narrow in nature) with good level maintained to old age and some subtests even rising (17, p. 158).

A most vital point, of clarification in the labyrinth of research, in the areas under consideration is contributed by Thorndike in his distinction between "learning" and "learning performance." He indicates that although he had demonstrated the rate of learning decreased gradually after 25, he conceded that later investigation by Jones and Hiles, made it probable that the decline in amount done is not much more than 1 per cent per hour per year in the age range from 45 to 70. Thus Thorndike in his use of the concept of amount per hour, Lorge interprets clearly, distinguishes between learning rate (as efficiency or performance) and learning ability (as power or potential). From the theoretical, as well as the practical, point of view, the distinction between performances and ability is fundamental. Learning is the power to learn; while learning performance is a function of the circumstance under which a person performs (12, p. 1-2).

In assessing certain types of current intelligence tests, Lorge resolved, "In general, the trend during the last three years has been toward the development of so-called short-form emergency, or rapid methods of appraising intelligence. While such methods may have value in the speedy classification of personnel, the resulting tests tend necessarily to become less reliable, less valid, and less global." He deplores the fact that the naive interpretation of intelligence scores is being continued; despite the fact that there are few studies pointing up the influence of experience, training, schooling, and remedial reading on such scores (14, p. 326).

When Lorge applied his correction for the penalties, that age forced on speed-power intelligence tests scores, to the studies by Jones and Conrad, and Miles and Miles, he records that the adjustment scores do not show the declines reported in these researches (13, p. 104).

Whenever learning ability is measured in terms of power ability without stringent time limits, the evidence is clear that the learnability does not change significantly from 20 to 60. Bright people do not become dull by 60, nor do dull people become moronic at sixty. Lorge's striking conclusion based on his research is to the effect: "An individual at 60 can learn the same kinds of knowledge, skills and appreciation at 60 that he could at 20 years of age." Owens, Corsini and Berkowitz all indicate that many intellectual functions do not decline with age and that such abilities as information and work knowledge even show a continuous improvement well into later adult years (14, p. 326).

Birren puts the matter quite aptly in expostulating. "Both cross-sectional

and longitudinal studies may be confronted with questions about differences in populations of the same age in different generations. . . ." He lends support to the opinions of other authorities in stating that it is reasonable to suspect that many differences between young and elderly persons are not due to aging but to differences arising from shifts in nutrition, nature of physical environment, education, public health, and attitudes (4, p. 23).

As a result of his study of a group of university faculty men, the older group being 60 or above, and the younger 25-35, with some comparability on the basis of professional specialization, Sward reports that there was a significant difference in favor of the younger men. These losses he attributes to the factors of disuse and the antifactor of the particular test used. He substantiates many other instances cited in this paper, to the effect, "The scales used simply do not divorce themselves from the effects of learning and experience." He considers the older men's field of interest, specialized knowledge and occupation, as pertinent to their performance and finally asserts: "An impairment of the higher mental processes is by no means an invariable concomitant of the years beyond sixty" (23, p. 478).

F. Concerning Samples

The question of reliability in the choice of samples and methods of conducting experimental studies leaves any kind of data in support of general decline very thin indeed. Shock points out that very few studies have been made in which the same subjects have been retested after a lapse of time and that most of the tests are inadequate to differentiate changing abilities at the upper levels of intelligence (7, p. 91). Concerning the difficulty of choosing the samples for standardization, Wesman thinks that there is bias in the representativeness of the sample. "Those who were most readily available to the examiners were singularly unrepresentative" (26, p. 216).

This idea of the inadequate methods of testing is pursued further by Watson in a striking way. He reports the facts that psychological studies of aged psychiatric patients are in main confined to clinical observations and research investigations of the personality of the nonpsychiatric aged individuals is almost nonexistent. He further states that psychiatric studies of the aging, moreover, partake of the weakness of much clinical psychiatric research—exclusive concern with the patients, grouped by diagnostic labels derived from an outmoded nomenclature (25, p. 310).

Granick, in his review of the old research literature (1927-1949) on the intellectual and personality function of people beyond the age of 40, indicates that there is a marked paucity of reliable information in many areas. On

the basis of reported findings which are not recent, he records that overall intelligence test performances show a marked progressive decline in relation to increase in age. However, on subtests such as vocabulary, general information and reasoning problems, in which speed is not a factor, older adults achieve as well as younger subjects. Memory functioning, efficiency of performance, and tasks involving relinquishing of old habits, however, are found to be difficult for old people (9, p. 55).

Pressey is definitive in asserting that the need for longitudinal studies is generally recognized and he is climactic in saying that the much glorified normal distribution ought to apply also to the aged, or aging, in this matter of intellectual ability (17, p. 118).

Commenting on the difficulty of locating and testing typical samples of adults, Thorndike shows that though adult tests are available, it is exceptional to find norms for representative adults provided for them. The great bulk of the tests, standardized upon adults had clearly been upon selected groups, he atests. Most adult tests represent norms for college students and hundreds of investigations have been made upon intelligence in college groups (24, p. 76).

G. Summary

Basing his opinions on experimental data, Lorge predicates that attitudes and interests determine the maintenance of intelligence. By underestimating their ability, the aging inhibit the continuance of the learning process. Interest, he proved, can be taught and learned at any age. Lorge submits that disliking any task is tantamount to prohibiting the learning of it. He concludes that people over forty learn almost as well as younger adults.

Thorndike supports the thesis that vital interests do not dry up with aging, while Pressey views the matter as a shift rather than a decline in interest. This latter concept is what Lorge characterizes as the crystalization of values learned in the early years.

Pressey considers the changes in the personality of the aging not so much a matter of biological decline as of social and psychological attitudes. They protect themselves by not venturing forth. His ideas are supported by Lorge who constantly stresses the significance of situational factors.

When learning is measured in terms of goodness rather than sheer quickness, Lorge observes, the learning curve does not show a decline for successive ages. He refutes the prevalant notion that aging and decline in intelligence are synonymous, in citing the fact that there is an indisputable correlation between schooling and intelligence test score. The older popu-

lation is at a disadvantage both in being further away from schooling and in having had less of it. Pressey asks satirically is it any wonder that the aging show poorer performance when measured in an education that they have never received.

One of the studies which demonstrates the significant correlation between ability and education concerns the contrast in the performance of veterans of World War I and World War II. The superior education of the latter was correlated with their superior performance on the intelligence test. Some studies demonstrate the inadequate methods of measuring ability, or the mistaken concepts concerning intelligence. Pressey intimates that we compare intelligence which we do not understand with emotion which is also in the realm of our ignorance.

Another triad of opinions is offered to enhance the opposition to current naiveté concerning the decline of intelligence in the aging. Ghiselli found no relationship manifested between age and intellectual ability in his study. Raven made the point that people who are above average in ability show an increase in intelligence even up to the age of sixty. Shock emphasizes that no mass decline in all subjects or abilities is evident in all areas, but rather in those areas not in active use by the average adult.

The difference in the performance between young and elderly persons, it is suggested, is not due to aging but to the difference arising from shifts in nutrition, nature of physical environment, education, public health, and attitudes. Pressey proposes that improved testing will show greater total score around thirty with good level maintained to old age and some subtests even rising. Evidence tends to indicate that samples of the aging population earned higher scores on certain types of tests. On subtests such as vocabulary, general information, and reasoning problems, in which speed is not a factor, older adults achieve as well as younger subjects. It has been proposed that since language is little affected by increasing separation from school it could be used as an adequate device for measuring intelligence.

A distinction has been made between learning rate, (as efficiency or performance) and learning ability (as power or potential). When learning ability is measured in terms of power ability without stringent time limits, the evidence is clear that learnability does not change significantly from 20 to 60. Bright people do not become dull at 60 nor do dull people become moronic at 60. To continue learning may keep mental ability limber and maintain habits of wide application. Owens, Corsini and Berkowitz all indicate that many intellectual functions do not decline with age and that

such abilities as information and work knowledge even show a continuous improvement well into later adult years.

References

1. Bayley, N. Maintenance of intellectual ability in gifted adults. *J. Geront.*, 1955, **10**, 91-107.
2. Berkowitz, B. The Wechsler-Bellevue performance of white males past 50. *J. Geront.*, 1953, **8**, 76-80.
3. Birren, J. E. Handbook of Aging and the Individual: Psychological and Biological Aspects. Chicago: Univ. Chicago Press, 1960.
4. Botwinick, J., *et al.* Set in relation of age. *J. Geront.*, 1957, **12**, 300-305.
5. Bromley, D. B. Some experimental tests of the effect of age on creative intellectual output. *J. Geront.*, 1956, **11**, 74-82.
6. Brown, M. N. A critique of Wechsler-Bellevue system of weighted scales. *J. Clin. Psychol.*, 1949, April, 170-173.
7. Bureau of Employment. Ability is ageless. *Employment Security Rev.*, 1960, **27** No. 11, 28.
8. Ghiselli, E. The relation between intelligence and age among superior adults. *J. Genet. Psychol.*, 1957, **90**, 131-142.
9. Granick, S. Studies in psychology of senility: A survey. *J. Geront.*, 1950, **5**, 44-58.
10. Heglin, H. Problem solving set in different age groups. *J. Geront.*, 1958, **11**, 310-317.
11. Holden, J. E. A survey of participation in adult education classes. *Adult Leadership*, 1958, April, 158-261.
12. Lorge, I. The Adult Learner. In manuscript, Teachers College, Columbia Univ., New York.
13. ———. Influence of test upon the nature of mental decline as a function of age. *J. Educ. Psychol.*, 1936, **27**, 100-110.
14. ———. Intellectual changes. *Rev. Educ. Res.*, 1947, **17**, 326-332.
15. Miles, C. C. The influence of speed and age on intellectual levels of adults. *J. Genet. Psychol.*, 1934, **10**, 208-210.
16. Owens, W. A., Jr. Age and mental abilities. *Genet. Psychol. Monog.*, 1953, **48**, 3-54.
17. Pressey, S., *et al.* Psychological Development Through the Life Span. New York: Harper, 1957.
18. Raven, J. C. The comparative assessment of intellectual ability. *Brit. J. Psychol.*, 1948, **39**, 12-19.
19. Ruch, F. L. The differentiative effect of age upon learning. *J. Gen. Psychol.*, 1934, **11**, 261-286.
20. Shakow, D. The effect of aging on the Stanford-Binet vocational score of adults. *J. Educ. Psychol.*, 1938, **29**, 241-256.
21. Shock, N. W. Gerontology. *Ann. Rev. Psychol.*, 1951, **2**, 353-370.
22. ———. Aging and psychological adjustment. *Rev. Educ. Psychol.*, 1952, **22**, 439-448.
23. Sward, K. Age and mental ability in superior men. *Amer. J. Psychol.*, 1945, **58**, 343-379.
24. Thorndike, R. L. Verbal intelligence of the American adult. *J. Gen. Psychol.*, 1944, **30**, 75-85.

25. Watson, R. I. The personality of the aged: A review. *J. Geront.*, 1954, **9**, 310-314.

26. Wesman, A. C. Standardizing an individual intelligence test on adults: Some problems. *J. Geront.*, 1955, **10**, 216-219.

Department of Psychology—Education
Kentucky State College
Frankfort, Kentucky

The Journal of Genetic Psychology, 1963, **102**, 189-194.

AGE DIFFERENCES IN RELATIONS BETWEEN CFF AND APPARENT MOTION*

Section on Aging, National Institute of Mental Health

JACK BOTWINICK AND JOSEPH F. BRINLEY

A. INTRODUCTION

Critical flicker fusion (CFF) involves intermittent stimulation by a single light source. Apparent motion (AM) involves the intermittent stimulation of two or more light sources in specific phase relations. It would seem, therefore, that thresholds for CFF and AM would likely be related. One purpose of this study was to examine this possibility.

Thresholds of CFF are known to be lowered with advanced age (1, 2), as are thresholds of AM (3). A second purpose of this study was to determine whether, if AM and CFF thresholds were related, their relation would be the same in advanced age as in earlier life.

B. METHOD

1. *Subjects*

The *S*s were 43 volunteers of two age groups. The younger comprised 27 *S*s aged 18-27 years, and the older group comprised 16 *S*s aged 63-80 years. Median ages were 20 and 71.5 years respectively. All *S*s were community residing and in apparent good health. Two *S*s in the elderly group and four *S*s in the younger group were women; the remainder were men.

2. *Apparatus*

The electronic apparatus employed involved two circular sources of light illuminated by Sylvania glow modulator tubes (1B59/R113013). The apparatus permitted constant flicker rates with variations in on-off ratios, and in cycles per second from 1 to 60. The light dark ratio of 50-50 was used.

The two glow tubes were mounted side by side in a wood board painted flat black so that only the two circular light sources were seen by *S*. Each light source was approximately 1/8 inch in diameter and the two were separated approximately 1 and 3/8 inches from the two centers. The glow

* Recommended for publication by James E. Birren of the Editorial Board, received in the Editorial Office on December 14, 1962, and given prior publication in accordance with our policy regarding manuscripts on the subject of aging.

of the tubes were seen as a rose or peach color and was viewed in a fully illuminated room from a distance of approximately 7.5 feet, subtending an angle of one degree of visual arc.

3. *Procedure*

For CFF, one of the two circular light sources was hidden by a flat black cover made of the same type of wood board as the one in which the glow tubes were mounted. *S* was shown exposures of obvious flicker and obvious non-flicker, and told to say "yes" to flicker and "no" to the fusion state.

Each *S* gave three "correct" responses before an ascending series for threshold determination was made. Each *S* was then given 14 additional series; seven were ascending and seven were descending series, given in quasi random order. The flicker stimulus was presented for 2.5 seconds with an interstimulus interval of 4.0 seconds. The threshold for each *S* was computed as the median of the 15 series.

For AM, the two light sources were used with the same exposure and interstimulus durations as with CFF. The two light sources were completely out of phase, and thus, were presented with twice the cycles per second as with the one light source of CFF.

It became clear in preliminary experimentation that *S*s appeared to use two types of criteria for judging AM. Some *S*s appeared to report AM only when they perceived transit across the gap of the two light sources. Some *S*s appeared to report AM with any type of motion. The result made for wide individual variation and it was decided to structure the tasks to capitalize on the two apparent modes of judgment. Accordingly, two AM thresholds involving two types of instruction were obtained.

In the first AM determination, always made after CFF, *S* was instructed to say, "yes," when he perceived "any motion in the left-right dimension—as though one or both the lights appeared to be moving in and out from the center." *S* was encouraged to use this criterion of *any* motion when it appeared as if he was not doing so. As in CFF, the median threshold of 15 series of ascending and descending orders was used. These thresholds will be referred to as AM_1, as differentiated from AM_2 which followed for each *S*.

For AM_2 *S* was instructed to "say, 'yes,' when the lights appear to swing completely across the gap and to say 'no' when this does not occur even though they appear to move in and out from the center." Here also, 15 ascending and descending series were given and the median threshold used for each *S*.

C. Results

The results of this study were presented in Tables 1 and 2. It may be seen in Table 1 that thresholds of CFF and of AM_1 were significantly correlated in the elderly group, but the correlation of the measures in the young aged group was short of statistical significance. Conversely, thresholds of CFF and AM_2 were uncorrelated in the elderly group, but significantly correlated in the younger group. Measures of AM_1 and AM_2 were uncorrelated.

TABLE 1
Product Moment Correlation Coefficients Among Two Measures of Apparent Motion (AM_1), (AM_2), and Critical Flicker Fusion (CFF)

	Age	
	Elderly	Young
CFF-AM_1	.80*	.34
CFF-AM_2	.02	.49*
AM_1-AM_2	.09	.13

* Significant beyond the 1 per cent level; remaining correlation coefficients not significant at 5 per cent level.

In Table 2 it may be seen that the mean threshold of CFF was significantly lower in the elderly group than in the younger group ($p < .01$ by t-test), but that this was not the case with either of the two measures of apparent motion ($p > .05$).

These results do not include the data of *S*s who failed to report measurable thresholds in all three tasks. One young and two elderly *S*s did not report

TABLE 2
Two Thresholds of Apparent Motion (AM_1), (AM_2), and Critical Flicker Fusion (CFF) in Relation to Age

	Cycles/Sec.	CFF*	AM_1**	AM_2**
Elderly ($N = 16$)				
	Mean	25.2	20.0	6.8
	Median	24.5	21.5	5.5
	SD	2.5	6.4	3.9
Young $N = 27$				
	Mean	32.4	22.6	5.0
	Median	32.0	24.0	5.0
	SD	2.5	8.0	1.8

* Mean difference between age groups significant at 1 per cent level.
** Mean difference between age groups not significant at 5 per cent level.
AM_1 and AM_2 mean difference significant at 1 per cent level for both age groups.

movement in AM_1, and one elderly *S* failed to report movement in either of the AM tasks. When the data of the three *S*s who reported movement in AM_2 but not AM_1 were included, the correlation for the young group between CFF and AM_2 dropped to .27. The remaining data of Tables 1 and 2 remained essentially the same.

D. Discussion

This study was performed to investigate two questions. One involved the relation between critical flicker fusion and apparent motion, and the second involved differences between two age groups with respect to the relation. It was found that CFF and AM were related under some conditions, but not under others. The correlational results with respect to age groups were unanticipated and puzzling and, therefore, whatever interpretation may be imparted to these data must be regarded as tentative.

The two threshold measures of AM (any and transit motion) were uncorrelated and reliably different. It is clear from this that the instructions emphasizing different criteria of judging motion were different and independent for the *S*s. For elderly *S*s, the criteria of judging any apparent motion (AM_1) and judging flicker were related but the criteria for judging transit motion (AM_2) and flicker were not. The converse appeared to be the case for young *S*s, although here it might be reasonable to regard the two correlation coefficients involving CFF as similar, suggesting a low degree of correlation between CFF and both types of AM.

It is not clear why for the elderly, CFF was highly related to any apparent motion but unrelated to transit motion. It is especially unclear when it is considered that thresholds of both types of apparent motion were not markedly different between the two age groups. This lack of clarity, however, in no way modifies the empirical data. Interpretations must take into account the order in which the procedures were administered as well as the instructional sets of each of the procedures.

E. Summary

Thresholds of CFF and two types of apparent motion were obtained on *S*s in two groups. This was done to determine whether the thresholds were related, and if so, whether the pattern of relation was the same for both groups. One apparent motion threshold involved judgment of any motion (AM_1) and the other involved judgment of a transit type of motion (AM_2). *S*s were 18-27 years and 63-80 years. Statistically significant correlations were found between CFF and AM_1 in the old group, and CFF and AM_2 in the young group.

References

1. Coppinger, N. W. The relationship between critical flicker frequency and chronological age for varying levels of stimulus brightness. *J. Geront.*, 1955, **10**, 48-52.
2. Misiak, H. The decrease in critical flicker frequency with age. *Science*, 1951, **113**, 551-552.
3. Saucer, R. T. & Coppinger, N. W. Standard stimulus conditions for thresholds of apparent movement. *Amer. J. Psychol.*, 1960, **73**, 435-439.

Section on Aging, Laboratory of Psychology
National Institute of Mental Health
Bethesda 14, Maryland

The Journal of Genetic Psychology, 1963, **102**, 195-201.

THE EFFECT OF OBSERVATION ON CHILDREN'S REPRESENTATION OF THE SPATIAL ORIENTATION OF A WATER SURFACE*[1]

Institute for Social Research, Oslo, Norway

JAN SMEDSLUND

A. INTRODUCTION

In their book "The Child's Conception of Space," Piaget and Inhelder (5) describe certain phenomena relating to children's representation of horizontality. A number of children, between four and 11 years old, were shown some pictures of variously tilted bottles, and were asked to draw the water surface in these bottles. They were also asked to point out the correct one among sets of differently drawn model pictures. It turned out that children up to seven-eight generally did not have a conception of the invariant horizontality of the water surface. This very slow development is in apparent contrast to the fact that tilted water and milk bottles are among the frequent daily experiences of children. Even more striking was the observation that children who did not have any concept of horizontality, apparently did not seem to profit at all from a period of close observation of the water surface in an actual bottle that was tilted in all directions. Only children who already showed some beginnings of a conception of horizontality, did profit somewhat from direct observation.

Piaget and Inhelder interpret these findings in terms of their theory that there is never any direct feedback from the external world, and that the feedback always is determined by the way the subject assimilates the situation. The subject can only observe horizontality and deviations from it if he already has a schema of horizontality, and in the absence of this schema, no amount of observation will influence him. He is enclosed in an evil circle from which he can only emerge when the progressive development of spatial concepts gives rise to the beginnings of a schema of horizontality, which then may be empirically confirmed.

* Received in the Editorial Office on April 14, 1961.

1 A relevant unpublished study by Mlle. P. Dadsetan is referred to in *Les Mécanismes Perceptifs*. J. Piaget, pp. 222-226 (Paris: Presses Universitaires de France, 1961). The results appear to confirm the present one with respect to representation, and, in addition, indicate that even simple perceptual estimates of horizontality are difficult at five-six years.

This original study by Piaget and Inhelder was conducted by means of Piaget's flexible "méthode clinique" and the results were not reported in extenso. We have repeated the study in a more systematic and objective manner.

B. Procedure

Twenty-seven five- to seven-year-old children in a nursery in Oslo participated as subjects. The design involved a pretest, a period of observation and a posttest. Each subject was first shown a picture of a bottle half-filled with water, and was asked to notice the position of the water in the bottle. Then six pictures of bottles tilted in various directions were presented, one at a time, and the subject was asked to draw the water surface in each case. See Figure 1.

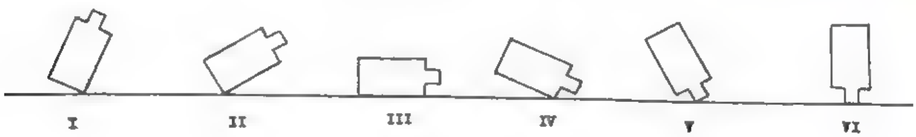

FIGURE 1
The Six Drawing-Test Pictures

Then a flat bottle half-filled with ink-water was presented. The subject was asked to pay close attention and the experimenter slowly tilted the bottle in steps of about 30° each time, with a brief period of rest in each position. The movement was continued 360°. After this, the initial six pictures of tilted bottles were presented again, and the subject was again asked to draw the water surfaces.

Finally, three sets of respectively eight, seven and eight model pictures of ink-water in a bottle were shown, and the subject was asked to point out the correct picture in each set. See Figure 2.

The scoring was open to a certain ambiguity, since it was sometimes difficult to decide whether a drawn line was approximately horizontal or not, and whether a drawing was improved from pre- to posttest or not. In order to make the procedure as reliable as possible, two judges scored the material independently. In the case of changes from pre- to posttest the categories of "better," "unchanged" and "worse" were employed. With six pictures and 27 subjects there were a total of 162 judgments to be made. The two judges agreed on 84 per cent of the cases. After some discussion and closer inspection of the drawings, agreement was reached on the remaining 16 per cent.

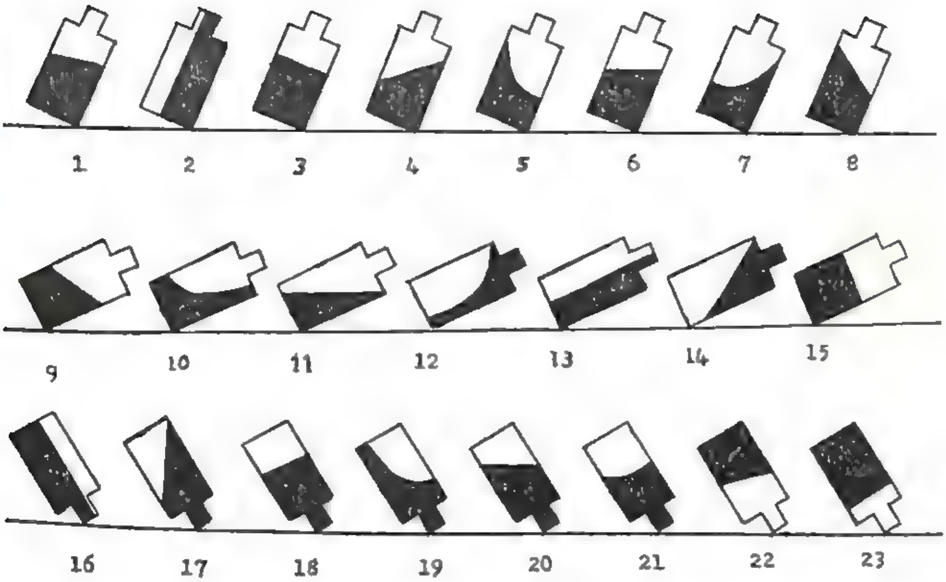

FIGURE 2
THE MODEL-CHOICE PICTURES

In the comparison between drawing on posttest and choice of model picture, the same ambiguity occurred. With the three categories "drawing better", "equal" and "choice better," the two judges agreed on 83 per cent of the 81 comparisons, and agreement was reached on the remaining cases after discussion and closer inspection.

C. RESULTS

The number of subjects with frequencies of correct drawing in the pre- and posttests as presented in Table 1.

The data in Table 1 show that one third of the subjects had no drawings correct in the pretest and only two subjects had all six correct. In the posttest there was a certain shift toward higher values in the middle categories, but the total number of subjects with no correct drawings and with all drawings correct remained unchanged.

TABLE 1
THE NUMBER OF SUBJECTS WITH VARIOUS FREQUENCIES OF CORRECT DRAWINGS IN THE PRE- AND POSTTESTS ($N = 27$)

Number of correct drawings	0	1	2	3	4	5	6
Frequency on pretest	9	8	5	2	1	0	2
Frequency on posttest	9	3	8	2	3	0	2

The changes of the individual subjects may be represented in terms of changes in number of correct drawings and in terms of the more sensitive measure of number of improvements vs. deteriorations. Table 2 presents the outcome of a comparison based on the former measure. The 25 subjects who had less than a perfect score in the pretest are divided into those who had no correct drawings in the pretest and those who had at least one correct drawing.

Table 2 shows a clear difference in the relative frequency of increment in number of correct drawings in the two groups. As to the size of the individual changes it should be mentioned that nine subjects had one more correct drawing and one subject had two more correct drawings. In terms of general improvement in drawings the difference between the two groups is even more pronounced. The results are shown in Table 3.

TABLE 2
THE NUMBER OF SUBJECTS WITH ZERO AND WITH ONE OR MORE CORRECT DRAWINGS IN THE PRETEST WHO INCREASE VS. DO NOT INCREASE THEIR NUMBER OF CORRECT DRAWINGS FROM PRE- TO POSTTEST (N = 25)

	Number of correct drawings in pretest	
	0	$\geqq 1$
Improvement	1	9
No improvement	8	7

TABLE 3
THE PRESENCE VS. ABSENCE OF IMPROVEMENT IN AT LEAST ONE DRAWING FROM PRE- TO POSTTEST IN THE GROUPS WITH NO CORRECT DRAWINGS AND WITH AT LEAST ONE CORRECT DRAWING IN THE PRETEST ($N = 27$)

	Number of correct drawings in pretest	
	0	$\geqq 1$
At least one improvement	1	15
No improvement	8	1

The data in Table 3 show that nearly all the subjects who have no correct drawings in the pretest, do not profit at all from the observations of an actual tilted bottle, whereas nearly all the subjects who showed some initial traces of horizontality, do improve their drawings somewhat.

The data on the relative difficulty of the six drawing-test pictures and on the improvement on these pictures from pre- to posttest are shown in Table 4.

Table 4 shows that pictures no. III and VI are clearly easier than the others and even have a tendency to improve their relative superiority from pre- to posttest.

TABLE 4
THE NUMBER OF CORRECT DRAWINGS OF THE SIX TEST PICTURES IN PRE- AND POSTTEST

	Picture I	II	III	IV	V	VI
Number correct in pretest	4	5	11	4	2	14
Number correct in posttest	6	4	16	3	4	16

Finally, we will report the findings concerning the choice among model-figures in the posttest. Table 5 shows the results of a comparison between drawing and model choice.

It may be gathered that the two tests are about equally difficult on the average. On the other hand, pictures I and V are clearly favorable to the choice-test and picture II to the drawing-test. Inspection shows that performance on the two tests is not very highly correlated; however, it is difficult

TABLE 5
THE FREQUENCY OF "DRAWING BETTER THAN CHOICE," "DRAWING AND CHOICE EQUALLY GOOD," AND "CHOICE BETTER THAN DRAWING" ($N = 81$)

	Picture I	II	V	Sum
Drawing better	7	14	7	28
Equal	8	7	9	24
Choice better	12	6	11	29

to find any exact measure of this interrelationship. The number of correct drawings and choices is too small to allow one to calculate a meaningful correlation in terms of correct vs. incorrect performance. The irregular and sometimes curvilinear drawings and model-figures makes it impossible to give any simple quantitative estimate of amount of covariation.

The relative frequency with which the alternative model-pictures are chosen, is presented in Table 6. The results show that the correct figures

TABLE 6
FREQUENCY OF CHOICE OF ALTERNATIVE MODEL-PICTURES
(Nos. 6, 11 and 20 are correct)

	Pictures							
Model pictures	1	2	3	4	5	**6**	7	8
f	3	5	4	7	2	3	1	2
Model pictures	9	10	**11**	12	13	14	15	
f	5	0	4	3	7	2	6	
Model pictures	16	17	18	19	**20**	21	22	23
f	4	3	3	6	4	1	3	3

are not chosen with any outstanding frequency. Even figures which depart radically from what is felt as reasonable by adult standards, are chosen fairly frequently.

D. Discussion

The results generally support the conclusions of Piaget and Inhelder. The general absence of a representation of horizontality in the given age group was verified. Likewise we have observed the intermediate stage of development where the child understands horizontality only when the bottle is lying on its side or standing on its head (5, p. 384). Finally, the absence of learning in children who have no initial conception of horizontality was clearly confirmed, as was also the limited improvements of those who have initial traces of a concept of horizontality.

The comparison between drawing and model-choice shows that, although the average difficulty is equal, the individual pictures seem to be of unequal difficulty in the two tests.

The apparent variations in the relative difficulty of drawing and choice from one picture to another, and the small number of pictures (three), prevents us from drawing any conclusions as to the relative difficulty of drawing and choice in other situations. Furthermore, the absence of a high intercorrelation between the two tests indicates that they cannot be very pure measures of the same underlying factor ("representation of horizontality"). Further research is needed to reveal what processes are involved in the responses to the tests.

The absence of effects of the period of observation on those subjects who showed no initial traces of a conception of horizontality, seems to be of some theoretical significance. The results support the general point of view that learning cannot be conceptualized in terms of a simple empiricism, where the organism acquires habits or expectancies as a function of direct contact with the external world. Instead, every contact with external reality is patterned according to the existing schemata of the subject. Thus, to the subject, his representation of the water surface is not contradicted by his perception of the water surface in the actually tilted bottle, because neither his representation nor his perception involves a placing into relationship of the water surface and the surface of the supporting table. This placing into relationship (mise-en-relation) probably occurs as a part of a gradual process of organization of the subject's representation of space. The real water surface (distal stimulus) may be horizontal and the projection of the lines of the water surface and the table surface on the retina (proximal

stimulus) may be parallel; nevertheless, the subject who has no schema of horizontality will remain uninfluenced by any confrontation with these stimuli. Some recent studies in other areas have shown an analogous absence of effects of empirical control in the absence of relevant supporting schemata. Cf. Greco's (1) study of the learning of complex empirical rules, Morf's (2) study of logical inclusion and Smedslund's (6, 7) studies of transitivity of weight, and of multiple probabilistic cues. Piaget's models of assimilation/accommodation and equilibration represent the most advanced existing attempts to conceptualize these phenomena (3, 4). It seems likely that data of this type eventually will lead to a radical change in current models of reinforcement.

E. Summary

Some five- to seven-year-old children were shown a series of six pictures of bottles tilted in various ways, and were asked to draw the water surface in each bottle (pretest). Then a flat bottle half-filled with ink-water was presented and was slowly tilted in various ways. After this, the pretest was repeated and in addition the children were asked to choose the correct picture in each one of some sets of drawn model-pictures. The pretest results show a general absence of an adequate conception of the spatial orientation of the water surface, and an absence of effects of the period of observation in those subjects who had no traces of an adequate conception in the pretest. The average difficulty of drawing and model choice was the same, but with great variations in the individual subjects and pictures.

References

1. Greco, P. Induction, déduction et apprentissage. *Études d'Épistémol. Génét.*, 1959, **10**, 3-59.
2. Morf, A. Apprentissage d'une structure logique concrète (inclusion): Effets et limites. *Études d'Épistémol. Génét.*, 1959, **9**, 15-83.
3. Piaget, J. Logique et équilibre dans les comportements du sujet. *Études d'Épistémol. Génét.*, 1957, **2**, 25-117.
4. ———. Assimilation et connaissance. *Études d'Épistémol. Génét.*, 1958, **5**, 49-108.
5. Piaget, J., & Inhelder, B. The Child's Conception of Space. London: Routledge & Kegan Paul, 1956.
6. Smedslund, J. Apprentissage des notions de la conservation et de la transitivité du poids. *Études d'Épistémol. Génét.*, 1959, **9**, 85-124.
7. ———. The utilization of probabilistic cues after 1100 and 4800 stimulus-presentations. *Acta Psychol.*, 1961, **18**, 383-386.

Institute for Social Research
Muthes Gate 31
Oslo, Norway

The Journal of Genetic Psychology, 1963, **102**, 203-216.

FANTASY PRODUCTIONS OF CHILDREN WITH A PROGRESSIVELY CRIPPLING AND FATAL ILLNESS*[1]

Teachers College, Columbia University

ROBERT S. McCULLY[2]

A. INTRODUCTION

Little is known about how a human being copes with the idea that he may suddenly cease to exist. Neither psychological theory nor the body of psychological literature has given the reality of death much attention. The existentialists and certain psychoanalysts have approached the matter speculatively, or at best in extremely broad scope. Much research needs to be done before we can understand the meaning of the impact of the termination of life.

Recently, Feifel (5) has edited a book which treated the general subject of death in a broad sense. Several authors (2, 3, 14) have considered children's concepts and attitudes toward death. Two studies (13, 16) have considered the reactions of children who were actually dying. Both of these studies reported a resigned and fatalistic attitude in their subjects. No studies at all have appeared in which children actually faced death and yet were not at the same time in the terminal stages of illness.

1. *Present Study*

This study is concerned with the fantasy productions of a group of children who knew the overhanging threat of death as a real phenomenon which would confront them. The purpose was to throw light on the psychological world in which they lived, such as might be reflected in their recorded fantasy productions obtained in association with ambiguous picture stimuli. These children were in the unique situation of suffering from a progressively

* Accepted for publication by Arthur T. Jersild of the Editorial Board. Received in the Editorial Office on April 24, 1961.

[1] This study is a condensation of a dissertation submitted in partial fulfillment of the requirements for the Ph.D. degree at Columbia University. The writer wishes to express his apprecation to Dr. A. T. Jersild for his guidance in the study and for his critical evaluation in preparation of the present manuscript.

[2] Now at Cornell University Medical College, and The New York Hospital (Payne Whitney Psychiatric Clinic). Appreciation is expressed to Dr. A. T. Milhorat, Dr. A. C. Sherwin, The Muscular Dystrophy Associations of America, Inc., the Hospital for Special Surgery, and New York City Public School 183 for assistance in making possible the collection of the data.

crippling illness that was certain to be fatal (childhood muscular dystrophy), and was known so by the children themselves. Their own awareness of this was made clear to the investigator through personal communication with the children and their parents. Their fantasy productions were compared with the fantasies of children who were crippled but did not face the prospect of early death (poliomyelitis), and with children who had neither condition to face (normal).

Childhood muscular dystrophy offered the possibility of exploring the subjective nature of their fantasy, how the idea of death was experienced in the fantasy of children who were going to die, and what attitudes toward the future were in the fantasies of children who had little future to expect. With these ideas in mind, it was hypothesized:

(1) That the dystrophy group relies more extensively on fantasy than do the other groups. Therefore, concept-dominated[3] themes (those which stem from inner demands) as opposed to picture-dominated themes (those which stem from the picture stimulus itself); (*a*) appear with greater frequency; and (*b*) show a greater orginality than those of the other groups.

(2) That when, in response to any stimulus card, material is elicited which deals with death, disaster, or catastrophe, the dystrophy group are (*a*) less able to treat the fact of death or disaster consistently as a natural event in their fantasy than do the other groups; and (*b*) therefore tend to resolve catastrophic events in their stories by improbable or impossible solutions.

(3) That when fantasy material is produced which deals in any way with the future, the dystrophy group (*a*) tend more often to evade or ignore the future as shown by greater difficulty in ending themes; and (*b*) are less realistic or practical about future events than are the other groups.

2. *The Illness*

Childhood muscular dystrophy (pseudohypertrophic progressive muscular dystrophy) is a fatal illness, the nature of which makes itself known through clearly progressive incapacitation. This illness is different from all other muscular handicapping diseases because it is slowly progressive, with death expected around puberty or early adulthood. It has an onset which is not sudden, the effects of the disease may begin to appear during infancy. However, no gross physical defects become obvious until around school age. The progressive, nonstatic nature of muscular involvement places these children

[3] A term introduced by Grassi and Levine (8).

in a status of gradually going backwards from an achieved level of motor skill. The cause of muscular dystrophy is unknown; however, it is an inherited condition. It occurs much more frequently in boys than girls.

3. *Setting and Subjects*

a. Dystrophy group. Fifteen boys, ranging from ten to 14 years of age were studied. As Table 1 shows, the mean age of the group was 12.0 years.

TABLE 1
MEANS, STANDARD DEVIATIONS, AND RANGES OF AGE AND VERBAL INTELLIGENCE FOR THE SUBJECTS

Group	IQ			Age (in years)		
	Mean	*SD*	Range	Mean	*SD*	Range
Dystrophy	103	11.7	90-130	12.0	1.75	10-14
Polio	107	8.25	90-126	11.71	1.0	10-14
Normal	105	13.0	90-132	11.44	.62	10-14

A day care school operated by the New York City Public School System in the Payne Whitney Clinic of The New York Hospital was formed for these children. None of the children was hospitalized. All were confined to wheel chairs. Their classrooms and play spaces were entirely separate from the activities of the hospital. They were transported to and from the hospital in a special bus which was provided by The Muscular Dystrophy Associations of America, Inc.

Only children known to have at least average verbal intelligence were included in the group. This was determined by a standard intelligence test (Wechsler Intelligence Scale for Children). All were from the lower middle socioeconomic range. The only other selective factor in forming the group was residence within range of transportation.

b. Polio group. Fifteen boys in the same age range as that of the dystrophy group, who had become crippled because of poliomyelitis, were also studied. These children were selected from the registry of the out-patient polio clinics of the Hospital for Special Surgery. None of the children was hospitalized. Selection was based on equivalent socioeconomic range, presence of at least average verbal intelligence, and a physical handicap which involved the lower extremities.

c. Normal group. Fifteen boys of an age range equivalent to the other groups, who were attending Public School 183 of the New York Public School System, were studied. This school was in the neighborhood of The New York Hospital. Selection was based on equivalent socioeconomic range,

and the presence of at least average verbal intelligence. No form of physical handicap was present in this group.

B. Method and Procedure

In order to determine how fantasy served these children, and whether it differed from that of normal or other handicapped children, six of Murray's TAT cards were selected on the basis of their probable relevance to the sex and age group being studied (Cards 1, 8BM, 13B, 11, and 14). Cards 9 and 10 from the Michigan Picture Series were included. In addition, two special pictures devised by the author made a total of ten stimulus pictures.

The procedure was to present each subject individually with the same ten stimulus pictures. Identical instructions were given each time and they were based on the instructions described by Murray (12) as suitable for children in his TAT manual.

A description of the less familiar pictures and the experimental ones chosen follows:

Michigan Card 9	A flash of lightning extends from sky to earth. Blobs of lights dot the lower part of an otherwise darkened background.
Michigan Card 10	Four boys walk along a rustic, tree-lined country road in the summertime.
Special Card	A boy holds his father's hand as each looks out from a hilltop into the horizon. The picture offers stimulation for thoughts about the future.
Special Card	A little girl is stooped over a bird lying on its back with its feet up in the air. The scene is snow covered and a church with tiny tombstones beside it appears in the background. Thus, a stimulation is offered for thoughts about death.

One hundred fifty thematic productions were obtained with these pictures from each of the three groups.

1. *Analysis of Data*

All of the thematic productions were analyzed by the investigator according to categories which were developed and defined to test the hypotheses. The categories were devised empirically from an extensive sampling of the data, and were organized according to the demands of each hypothesis. A simplified scoring sheet was provided for each production that each subject gave. Detailed instructions, definitions, and examples were developed for scoring

purposes and use by the investigator and two independent judges. The stories were typed on separate sheets and coded so that the subjects could not be identified.

Thus, the scoring procedures organized the data in such a way as to apply to each hypothesis or part of an hypothesis separately. Under the first hypothesis, the frequency of concept and stimulus oriented themes was determined, and the degree of originality in the nature of themes was rated according to instructions. Under the second hypothesis, the scoring procedures were designed to determine the presence or absence of disaster, death, or catastrophe. Then, when material of that nature was present, it was classified in such a way as to allow ratings about how the particular kind of catastrophe in question was handled or resolved. Under the third hypothesis, the scoring procedures classified the nature of the endings for the themes and determined the presence or absence of an outcome. Then, outcomes and endings were classified according to the presence or absence of considerations about the future, and when such considerations were present, they were rated qualitatively in accordance with the instructions.

2. *Judging*

Two independent judges and the investigator scored twenty per cent (90) of the total number of stories (450) according to a detailed set of definitions and instructions. The judges were experienced psychologists accustomed to dealing with thematic materials. The materials that were judged independently were produced by nine of the 45 subjects, three subjects from each of the groups. The only consideration in selecting these three subjects from each group was that of making sure the subject had produced stories of a length that typified his group. Table 2 shows the average per cents of agreement among judges and investigator. The high agreement among the judges served as an indication of the investigator's consistency of judgment. The data were then submitted to statistical analysis.

TABLE 2
Average Per Cent of Agreement Among Judges (Entire Series of Ninety Themes)

Judges	Per cent agreement	Proportion
A & B	93.4	680/728
A & C	91.9	669/728
B & C	94.1	691/734
A & B & C	90.2	657/728*

* A & B & C agreement on 657 out of a possible 728.

3. *Statistics*

A nonparametric statistical method, The Extension of the Median Test (19) was employed in order to test the independence of the samples and to determine the significance of observed differences between paired samples.

For each hypothesis, two general approaches were employed. First, the null hypothesis was tested in order to ascertain whether or not the three groups did in fact constitute independent samples (D-P-N in Table 3). Secondly, comparisons were made between all possible combinations of the groups (D-P, D-N, P-N in Table 3) to determine the extent to which each group contributed to the overall variance, i.e., where exactly the significant distinctions lay.

A detailed account of the statistical treatment, as well as further description of the scoring categories and explicit illustrative examples, may be found in the more extensive account of the study on which the present paper is based.[4]

C. Results and Conclusions

When the three groups were compared as a unit, the statistical tests showed them to be significantly independent samples. As Table 3 shows, when the muscular dystrophy and normal groups were compared separately, all statistical tests of the hypotheses were significant at the .05 level, with the majority being at the .01 level or better. When the muscular dystrophy subjects were compared with the normal subjects, their fantasies reflected a greater reliance on the use of fantasy, and a far greater incidence of concept-dominated and imaginative themes. Their fantasies showed much more concern with catastrophe, death, and disaster than did those of the normal group. When such material was introduced into fantasy, they tended to resolve or handle catastrophe significantly less realistically than did the normals. The muscular dystrophy group failed to produce outcomes for more of their themes than did the normal group, and, when outcomes were given, they were less demarcated and more qualified. In general, the outcomes of the themes of the muscular dystrophy group were more unrealistically handled than those of the normal group, whether or not the future was considered in the outcome.

The muscular dystrophy and poliomyelitis groups were not significantly different in several respects. The poliomyelitis group was not significantly different from either of the other groups in the frequency of using concept-dominated themes, the appearance of imaginative themes, and the presence of catastrophe in their fantasy material. Even though the differences were not

[4] Ann Arbor, Mich.: University Microfilms, Inc. (Mic. 61-1080), 1961, 112 pp.

TABLE 3
TESTS OF INDEPENDENCE AND OF SIGNIFICANCE OF DIFFERENCES BETWEEN GROUPS

Hypothesis	Scoring unit*	Group	Chi square	Level of significance
I	Part One I: (a vs. b + c) (stimulus vs. concept)	D-P-N	11.92	.01
		D-P	.66	NS
		D-N	11.32	.001
		P-N	1.2	NS
I	Part One II: (a + b vs. c + d) (Descriptive-popular vs. original-imaginative)	D-P-N	8.52	.02
		D-P	2.26	NS
		D-N	8.4	.01
		P-N	.66	NS
II	Part Two I: (a vs. b) (Catastrophe present vs. catastrophe absent)	D-P-N	14.60	.001
		D-P	2.26	NS
		D-N	8.4	.01
		P-N	.66	NS
II	Part Two III: (a + d) (catastrophe accepted as natural event or handled realistically)	D-P-N	8.73	.02
		D-P	3.32	NS
		D-N	8.66	.01
		P-N	5.46	.02
II	Part Two III: (b + c + e + f + g + h) (catastrophe handled in unusual fashion or unrealistically)	D-P-N	19.92	.001
		D-P	13.46	.001
		D-N	19.26	.001
		P-N	1.2	NS
III	Part Three I: (a vs. b + c) (outcome given vs. no outcome)	D-P-N	6.60	.05
		D-P	6.0	.02
		D-N	3.86	.05
		P-N	1.2	NS
III	Part Three II: (a vs. b + c + d) (no difficulty in ending vs. no ending or difficulty with ending)	D-P-N	14.58	.001
		D-P	6.52	.02
		D-N	8.66	.01
		P-N	3.32	NS
III	Part Three IIIa: (a + c + d + e) (future not treated, situation resolved unrealistically)	D-P-N	10.32	.01
		D-P	7.06	.01
		D-N	8.66	.01
		P-N	.66	NS
III	Part Three IIIa: (b) (future not treated, situation resolved realistically)	D-P-N	21.52	.001
		D-P	13.32	.001
		D-N	19.26	.001
		P-N	2.26	NS
III	Part Three IIIb: (g + h + i) (future treated, situation resolved unrealistically)	D-P-N	13.18	.01
		D-P	9.72	.01
		D-N	16.12	.001
		P-N	9.72	.01
III	Part Three IIIb: (f) (future treated, situation resolved realistically)	D-P-N	11.98	.01
		D-P	3.32	NS
		D-N	4.92	.05
		P-N	1.72	NS
	Part Four: (a vs. b) (future of characters considered whether story carried into future or not vs. future not considered)	D-P-N	2.86	NS
		D-P	0	NS
		D-N	2.26	NS
		P-N	2.26	NS

* *Scoring unit* refers to groups of scores in support or not in support of an hypothesis. *Group* refers to any particular combination of groups under consideration.

significant, a greater percentage of the poliomyelitis subjects produced themes which accepted catastrophe as a natural event than did those of the muscular dystrophy group. The same can be said for a realistic resolution of situations when the future was considered in the outcome. As Table 3 demonstrates, in all the other areas measured, the poliomyelitis and muscular dystrophy groups were significantly different.

The poliomyelitis and normal groups were significantly different in two of the areas considered. The first of these was in the unrealistic solutions of themes when the future was considered in fantasy. The second was in the realistic treatment of events following the introduction of catastrophe into fantasy. These were the only instances in which the poliomyelitis group was significantly different from the normal group alone.

The expected differences between the muscular dystrophy and normal groups were confirmed in every instance on the scoring measures. The poliomyelitis group tended to be much more like the normal group, though not invariably, lining up with one group or the other as the conditions varied. This sometimes intermediate position of the poliomyelitis group was not surprising, since it shared some of the experiences and expectations of each of the other groups.

The characters and plots of the dystrophy group were much more removed from what might be expected to occur in real life than those found in the other two groups. However, none of the characteristics which emerged as common to the other two groups was absent in the dystrophy group. The differences were largely a matter of degree.

D. Discussion

It has been shown that the dystrophy group differed significantly from the other groups in certain aspects of their fantasy. To the extent that their thematic fantasies reflected the psychological world in which they lived, one can say that it appeared to be a world crowded with imaginative activities. These endeavors were often related to matters close to their own prospects and fate.

A look at certain theoretical views about the nature of fantasy may help explain the data at hand. Jung (11) distinguished between imagination and fantasy (or "directed thinking" and "fantasy thinking"). He stated that imagination involves the deliberate manipulation of concepts which are not necessarily unrealistic, but characterized by novelty. Fantasy was described as a passive attitude toward occurrences of unrealistic images in one's mental life. He remarked that imagination produces innovations and

adaptation, it copies reality and tries to act upon it. Fantasy turns away from reality, sets free subjective tendencies, and as regards adaptation, is more passive and less directly creative.

The concept-dominated stream of images which was found so often in the dystrophy group was much more like the setting free of subjective images, which Jung believed distinguished fantasy, than the novel combination oriented to reality which was said to characterize imagination. It should be made clear that such qualities were characteristic trends present in the fantasies of the dystrophy children, and by no means wholly describe the total nature of their fantasy. But the question is, are there any clues as to the function of these important trends, and what may be their relation to the circumstances these boys face?

In her study of fantasy in childhood, Griffiths (9) came to the conclusion that fantasy served the child in undertaking the resolution of a problem. She stated that symbolism tended to bring a problem close to an emotional attitude about it, especially when the problem was something which could not be readily understood. This enabled the child to accomplish in a simpler medium what might otherwise be beyond his powers. Hence, through a multiplication of the symbols that clothe subjective ideas, the child comes increasingly into contact with new aspects of objective experience.

Freud (6) noted that, in their play, children repeat even the unpleasant experiences. He stated that through this kind of activity the child gains a more thorough mastery of the strong impression than would otherwise be accomplished. He stated that every fresh repetition seems to strengthen this mastery for which the child strives.

It is possible that the concerns of the dystrophy group were less a repetitive mirroring of their handicaps and prospects than a way of trying to cope with them. Also, their fantasy may have combined both possibilities. Symonds (20) has pointed out that the fantasies of the early adolescent tend to be violent and exaggerated. The characteristics Symonds has indicated were much more typical of the poliomyelitis and normal groups than of the dystrophic boys. Unlike the other two groups, the images and events in the fantasies of the dystrophy children were seldom connected with outer possibilities, such as tying them in with family figures or school, seemed much less directed by deliberate guidance, but seemed more a parade of subjective material, partly conscious and partly in the half-shadow. This seemed like the fantasy Jung defined, the focusing and refocusing by children described by Griffiths, and Freud's suggestion that repetitive efforts can be geared to mastery.

Some aspects of the fantasy of the muscular dystrophy group could be interpreted as compensatory. Freud (7) defined compensation as any effort to exclude a painful awareness of any deficiency. Fantastic feats of strength and events dependent on physical prowess appeared in the dystrophic boys' stories. It may be expected that any child might use his imagination to conjure up more favorable circumstances for himself. Nevertheless, it can hardly be considered compensatory, under Freud's definition, to focus directly and so frequently on the very thing one should be compensating for (death and disaster). Time and again, catastrophe, disaster, or death were introduced, and this became a point of departure from what had been under consideration before, and that train of thought would wend its way to some new form of disaster and so on. This phenomenon seemed rather like an array of images which introduced themselves, followed by a deliberate effort to push them on (and it was in just such moments that fantastic and sometimes unrealistic treatment of the events appeared), and then a new array appeared. An illustration may help to make the qualities described more tangible. The following is an excerpt from a long story produced by a dystrophic boy in response to Michigan Card 9:

> . . . The boy shot a deer and dragged him by the horns to the house. He opened the door and there was an old man sleeping on the chair. He and Mr. Carl became fast friends. Then one day the young man died and he, he buried him and then one day he went out to find some gold. He took all the stuff he needed and then went on for four days and came to a place and sat to rest. He got up and started to dig for gold and then he found it. He worked to chop some trees to build a house for three nights and three days. Then he went hunting and he kept through the woods and came to a cabin and found an old man dead in there. Then two men came and he pushed them into each other and ran to the cabin. He heard a noise outside. Then they found a bird's egg and took it into the house and kept it warm and it hatched into a baby eagle. He kept on feeding it until it grew up. Then the eagle gave him a wish which would come true. . . .

The stories of the dystrophic boys were frequently much longer than those given by the boys of the other groups. At least in trend, though not necessarily inevitably, their stories flowed on and on like Tennyson's brook.

A very different quality was attached to similar events in the fantasies of the other groups. For example, there was no dearth of violence and death in the normal group, but such events tended more often to form a coherent relationship to the context of the story, seemed to be introduced with a definite purpose in mind, and were connected to circumstances that might

happen to people they knew or events they had experienced. In the muscular dystrophy group, the catastrophes seemed to simply occur, or arise by themselves, and what happened in the story was more determined by the appearance of such events than by the sequence the subject had begun with. In the two control groups, it seemed that the subjects themselves were more in command and determined what happened in the story sequence directly, and used catastrophe to account for the kind of result they had in mind. However, these qualitative differences should not be considered as being exclusive to any one of the groups studied, and they might blend into one another. They refer to general or characteristic trends which appeared to occur more often in the different groups.

It does not appear that one can account for the differences in the fantasy materials of the muscular dystrophy group by calling them "emotionally disturbed." Even though these children were no doubt retarded in their emotional and social development, psychiatric opinion (18) has not regarded these same children as suffering from any major emotional disturbance. Sargent and Cox (17) studied the fantasy materials (TAT Themes) of two groups of boys in the same age as that of the boys in this study. One group was disturbed (the criterion for disturbance was that the child had received attention from a psychologist, psychiatrist, or social worker) and the other not. The only feature the dystrophic boys appeared to have in common with the disturbed group described by Sargent and Cox was the presence of more stories without outcomes. By and large, the characteristics of the muscular dystrophy group tended to resemble Sargent and Cox's (17) stable group more than their unstable group. It does not follow from this that the dystrophic group is therefore stable, but, like the group considered stable, they showed freedom to express feelings, and there were no signs of constriction of imagery, no matter what the content was actually like.

The question arises as to whether the more frequent absence of outcomes, the qualified endings, and the more unrealistic treatment of catastrophe and the future in the stories of the dystrophic boys were merely a denial of their own fate. Denial is said to be a frequent concomitant of a variety of illnesses and may accompany many stressful situations in life. Nathanson, Bergman and Gordon (15) have summarized the medical literature on denial as it has been encountered in physical illness. Does the recurrence of tragedy in their fantasies simply offer the opportunity to deny it? Since the data show that these boys were not unaware of realistic ways of handling catastrophe, and did use them in common with the other groups, why, then, did the

denial take such improbable channels when their materials showed they were well aware of more probable ways of resolving catastrophic events? The same may be asked about the way they handled the future in their fantasies. While it is by no means the only possible explanation, the investigator suggests that the concern with catastrophe which appeared so often in the fantasies of the dystrophic group may have been their way of experimenting with possibilities in relation to their own fate. From his studies of dreams of people faced with death, Jung (10) reported that the unconscious seemed very much concerned with *how* one dies, whether the inner attitude of the conscious fits death or not. Can one not draw on fantastic possibilities when so mysterious a thing as one's fate is in focus? We freely give the poets such license, and spare them a label.

Even though it has been shown that the muscular dystrophy group tended not to handle catastrophic events realistically, the fact that they concerned themselves with such events is very realistic. Perhaps the most important single finding in this study was not that they failed so often to produce outcomes, or that their outcomes and solutions were more unrealistic than those of the control groups, but that catastrophic events were abundantly present and not absent. The nature of their fantasies offered no evidence that they were unaware that tragedies, often so close to their own, existed, and they did not avoid recognition of the fact. This contrasts vividly with the abundance of evidence that adults tend to take great pains to deny a similar possibility in themselves. If the view that the abundant presence of catastrophe in the fantasies of the dystrophic children reflects their efforts to cope with their circumstances is a valid one, then it is eloquent testimony against the notion that the individual is passively shaped by the external forces which operate on him.

In word-association tests in connection with the galvanic skin response, Alexander and his co-workers (1) have shown that indifference or a conscious denial of concern about death may be accompanied by an emotional counterpart outside of the subject's awareness. This suggests that one should not consider denial alone as an explanation for what was going on in the fantasies of the dystrophic children. Cappon (4), Murstein (13), Richmond & Waisman (16) reported that their subjects, most of whom were actually in the terminal stages of illness, tended to become apathetic, depressed, or "bent themselves toward death." Admittedly, their subjects were chronologically closer to death itself than were the dystrophic boys at the time of this study, and perhaps individuals in the muscular dystrophy group would show similar drifting as the end approached. Nevertheless, the fantasy materials

produced by dystrophic boys of the present study did not show a resignation in relationship to their dim prospects. On the contrary, the nature of their fantasy suggested that they roamed more widely in it than did the control groups. Instead of having become constricted, they seemed dedicated to finding, in the one sphere that was freely open to them (fantasy), qualities of exploration and variation which seemed to the investigator to have been a tribute to the vitality of the human spirit.

E. Summary

The fantasy productions of a group of children with a progressively crippling and fatal illness (muscular dystrophy) were studied. The purpose of the study was to explore the nature of their fantasy as it might be related to their tragic circumstances. Their fantasy material was compared with the fantasies of children who were crippled, but did not face the prospect of early death (poliomyelitis), and with children who had neither condition to face (normal). The subjects were all boys, with an age range of ten to 14 years.

It was hypothesized that the muscular dystrophy children would rely more extensively on fantasy than would the other groups, that their fantasy would be more varied and original, that when their fantasies focused on disaster it would be less realistically treated, and that the future would be handled evasively whenever it appeared in their fantasies.

Story themes obtained from ten stimulus pictures were analyzed according to categories which were developed and defined in terms of the hypotheses. Two independent judges analyzed a representative quantity of the materials and statistical tests were applied to determine the independence of the samples and the significances of the differences among the groups.

When compared with the normal group, the dystrophic children produced more subjective, original, and fantastic themes. They tended to introduce themes of death and disaster more often, and such events were handled less realistically. They tended to produce fewer outcomes and to qualify their story endings more often. These outcomes were more unrealistic whether or not the future was considered in the outcomes. These findings were statistically significant.

Qualitatively, the fantasy of the poliomyelitis children stood in an intermediate position between the other two groups.

These materials were discussed in relation to general theoretical considerations about the developing child and the nature of psychological reactions to death.

References

1. Alexander, I. E., Adlerstein, A. M., & Colley, R. S. Is death a matter of indifference? *J. of Psychol.*, 1957, **43**, 277-283.
2. Alexander, I. E., & Adlerstein, A. M. Affective response to the concept of death in a population of children and early adolescents. *J. Genet. Psychol.*, 1958, **93**, 167-177.
3. Anthony, S. The Child's Discovery of Death. New York: Harcourt, Brace, 1940.
4. Cappon, D. The dying. *Psychiat. Quart.*, 1959, **33**, 466-490.
5. Feifel, H., *Ed.* The Meaning of Death. New York: McGraw-Hill, 1959.
6. Freud, S. Beyond the Pleasure Principle. New York: Boni & Liveright, 1926.
7. ———. In: A Comprehensive Dictionary of Psychological and Psychoanalytical Terms, H. English & A. English, *Eds.* New York: Longmans, Green, 1958.
8. Grassi, J. R., & Levine, K. N. The graphic Rorschach manual. *Psychiat. Quart.*, 1943, **17**, 261.
9. Griffiths, R. A Study of Imagination in Early Childhood. London: Kegan Paul, Trench, Trubner, 1935.
10. Jung, C. G. Wirklichkeit der Seele. Zurich: Racher, 1934.
11. ———. Symbols of Transformation. New York: Bollingen Series XX, Pantheon Books, 1956.
12. Murray, H. A. Thematic Apperception Test Manual. Cambridge: Harvard Univ. Press, 1943.
13. Murstein, B. I. Personality and intellectual changes in leukemia: A case study. *J. Project Techn.*, 1958, **22**, 421-426.
14. Nagy, M. The child's theories concerning death. *J. Genet. Psychol.*, 1948, **73**, 3-37.
15. Nathanson, M., Bergman, P. S., & Gordon, G. C. Denial of illness, (hemiplegia). *Arch. Neurol. Psychiat.*, 1953, **68**, 380-387.
16. Richmond, J. B., & Waisman, H. A. Psychological aspects of the management of children with malignant diseases. *A.M.A. J. Dis. Child.*, 1955, **89**, 42-47.
17. Sargent, H., & Cox, B. T.A.T. responses of emotionally disturbed and emotionally stable children. *J. Project Techn.*, 1950, **14**, 61-70.
18. Schoelly, M., & Fraser, A. W. Emotional reactions in muscular dystrophy. *Amer. J. Phys. Med.*, 1955, **34**, 119-123.
19. Siegal, S. Nonparametric Statistics for the Behavioral Sciences. New York: McGraw-Hill, 1956.
20. Symonds, P. M. The Dynamics of Human Adjustment. New York: Appleton-Century-Crofts, 1946.

Payne-Whitney Clinic
525 East 68th Street
New York 21, New York

The Journal of Genetic Psychology, 1963, **102**, 217-223.

CHANGING REACTIONS OF PREADOLESCENT GIRLS TO TASKS REQUIRING CREATIVE SCIENTIFIC THINKING*

Bureau of Educational Research, University of Minnesota

E. Paul Torrance

A. The Problem

It is well-known that extremely few women have achieved eminence as scientific discoverers or inventors. From experiments conducted by the author and his associates during 1958-59 (39), it became obvious that in the early school years girls were developing attitudes, interests, and even disabilities which would make it difficult for them to become scientific discoverers and inventors. Moreover, these trends were so strong as to suggest that the attitudes of girls in today's elementary schools might be such as to make difficult a healthy adjustment in our culture.

In an experiment involving the use of science toys, many girls in the fourth through sixth grades shrunk from participation. The experimenters frequently heard the comment, "I'm a girl. I'm not supposed to know anything about science." As a result, the performance of boys was significantly superior to that of girls on this task. In an individual test of product improvement, using the improvement of common toys to make them more fun to play with, boys had achieved superiority over girls by the second grade and increased it in the third (6).

After 13 months after the original study involving science toys, it was replicated in the fourth, fifth, and sixth grades with an alternate set of materials. During the conduct of the experiment it became quite obvious that a marked change had taken place among the girls in their behavior concerning tasks requiring creative scientific thinking. It is the purpose here to report and analyze some of the objective data collected and to attempt to determine the degree and nature of the observed changes.

B. Procedures

1. *Subjects*

The subjects of the study were the pupils enrolled in the fourth, fifth, and sixth grades of a university elementary school during two school years, 1958-

* Received in the Editoral Office on May 15, 1961.

59 and 1959-60. Twenty-five children were enrolled in each grade and were divided into five groups of five each. In a few groups one member was absent at the time of the experiment, but no group consisted of less than four members. In both years, the study was conducted during the spring quarter near the end of the school year (April in 1959 and May in 1960).

In 1959, 34 boys and 36 girls participated; in 1960, there were 32 boys and 38 girls. The proportion of boys and girls was about the same in all classes and an effort was made to keep the ratio 2:3 or 3:2 in each group. Although there is a wide range of ability among the children enrolled in this school, there is a disproportionately large number of high ability children and children from professional families.

2. *Experimental Procedures*

In each class, all five groups were tested simultaneously, each in a different room under a trained experimenter. In an attempt to maximize motivation, prizes of interesting science books were offered for the best group or team performance. In the orientation, the terms "group" and "team" were emphasized. To simplify the recording of observations and the reporting of results, each subject was given a colored arm band and observations recorded according to arm-band color.

Each group was provided a box of science toys and toy parts. In 1959, Science Toy Collection Number 2 of the Library of Science (59 Fourth Ave., New York 3, N.Y.) was used. This collection includes a sparkler, a finger trap, a pin trick, a four-ball puzzle, topsy-turvy top, a jumping top, a blow ball, a flying saucer, and nutty putty. To this collection was added a magnifying glass, a magnet, and a whistle. In 1960, Science Toy Collection Number 3 was used. This collection includes a bang gun, string telephone, siren, busy bee, calliope whistle, cat cry, tower of Hanoi puzzle, secret, Nim, square puzzle, something-for-nothing puzzle, and tetrahedron puzzle. In addition, a magnet and a magnifying glass were included.

Each group was given 25 minutes in which to explore and experiment to discover what could be done with the toys and toy parts and why they function as they do. It was emphasized that in addition to figuring out what each toy was intended to do they should try to think of other uses. Five minutes were then allotted for planning and organizing the demonstrations and explanations. The group then demonstrated and explained the principles which they had figured out. The time limit was 25 minutes. Finally, each subject was asked to rank each member of his group according to the value of his contribution to the group's success. In addition, in 1960,

subjects were asked how well they enjoyed the activity and how well they thought their group would compare with the other four groups.

The experimenters tabulated on a specially prepared record sheet the number of ideas initiated by each subject during the exploratory phase and recorded all of the ideas demonstrated and explained during the subsequent phase. In addition, observations were made concerning how the group organized itself and got underway, how the members grouped themselves during the exploratory period, the general activity level, the roles developed by specific members, how the group planned the demonstrations, and the like.

C. Results

In 1959, boys were far ahead of girls on ideas demonstrated and scientific principles explained, averaging 6.18 and 4.65 respectively compared with 3.06 and 1.78 for girls. In 1960, the means for boys and girls were almost identical, 4.47 and 2.33 for boys and 4.34 and 2.11 for girls.

The analysis of variance data to test the significance of the observed differences in means are presented in Table 1. On ideas demonstrated and principles explained there is no significant effect due to year but there as significant effects due to sex and interaction. It will be recalled that girls tended to go up and boys to go down on both of these measures.

TABLE 1
Analysis of Variance Data to Test Significance of Sex and Year Differences in Performance on the Science-Toy Task Among Pupils in Grades Four Through Six

Performance variable	Sources of variance	Degrees freedom	Mean squares	F-Ratio	Level of signif.
Ideas demonstrated	Year	1	0.3491	0.35	NS
	Sex	1	93.7293	9.11	$<.01$
	Interaction	1	76.8551	7.47	$<.01$
	Error	136	10.2898		
Principles explained	Year	1	27.5979	3.28	NS
	Sex	1	85.1226	10.11	$<.01$
	Interaction	1	59.7176	7.09	$<.01$
	Error	136	8.4195		

We can now test the differences in means for boys and girls separately for each of the two years. These tests are presented in Table 2. It will be observed that in 1959 boys demonstrated significantly more ideas and explained significantly more scientific principles than did girls. In 1960, however, the performance of girls does not differ significantly from that of boys.

TABLE 2
TESTS OF SIGNIFICANCE OF DIFFERENCES IN MEANS FOR BOYS AND GIRLS IN 1959 AND 1960 ON PERFORMANCE VARIABLES OF SCIENCE-TOY TASK

Performance variable	1959 Means Boys	1959 Means Girls	1959 F-Ratio	1959 Level of signif.	1960 Means Boys	1960 Means Girls	1960 F-Ratio	1960 Level of signif.
Ideas demon.	6.18	3.06	13.09	$< .01$	4.47	4.34	0.03	NS
Princ. expl.	4.65	1.78	11.38	$< .01$	2.33	2.11	0.21	NS

Since girls contributed as much to the scores of their groups as did boys, it is of interest to know whether or not their contribution to the success of their groups was valued to the same extent as that of boys. Composite ranks were determined by adding the individual rankings and then ranking the totals. Table 3 presents a comparison of the composite rankings of girls and boys for each of the two years. It will be seen that in both years the contributions of boys are more highly valued than those of girls. There is no significant change in the rankings of boys or of girls between 1959 and 1960.

TABLE 3
COMPARISON OF COMPOSITE RANKINGS IN FIVE-PERSON GROUPS OF BOYS AND GIRLS FOR VALUE OF CONTRIBUTION TO SUCCESS OF GROUP ON SCIENCE-TOY TASK IN 1959 AND 1960[a]

Composite ranking	1959 No. boys	1959 No. girls	1960 No. boys	1960 No. girls
First	13	2	11	3
Second	6	7	7	7
Third	7	10	6	10
Fourth	4	11	2	15
Fifth	4	5	4	3

[a] In some groups, there were ties and in some groups one member was absent and was not ranked.

Note: Chi square (Boys 1959 vs. Girls 1959) = 12.04; $p < .01$.
Chi square (Boys 1960 vs. Girls 1960) = 14.92; $p < .01$.
Chi square (Boys 1959 vs. Boys 1960) = 0.74; not significant.
Chi square (Boys 1959 vs. Girls 1960) = 1.20; not significant.

In 1959, it was quite apparent that many girls did not enjoy participation in the experiment, stating that it was not an appropriate activity for girls. In 1960, each subject was asked to indicate how much he enjoyed or disliked participation in the experiment. Responses were made on a five-point scale but only one subject (a boy) used the dislike end of the scale. It was found that girls reported as much enjoyment of the activity as did boys. In fact, what little difference there is favors girls.

It is also important to know how boys and girls value their own contribution. The rankings made in both 1959 and 1960 required subjects to include themselves (except in one group in 1959 when one experimenter failed to obtain this information). The self-rankings of boys are compared with those of girls for the two years by means of chi square. It was found that there is a consistent but not quite statistically significant tendency ($p \cong .10$) over the two years for boys to value their contribution to their group's success more highly than girls value theirs.

D. Discussion

From the data which have been reported herein, it seems clear that the reactions of fourth, fifth and sixth grade girls in the elementary school studied have changed in significant and important ways during the period between April 1959 and May 1960. In 1959, boys demonstrated more ideas and explained more scientific principles than did girls. In 1960 in the same school, girls demonstrated as many ideas and explained as many principles as did boys. In 1959, many girls expressed obvious dislike for the science-toy task and tended to withdraw from active participation in it. In 1960, none of this dislike was observed. In fact, girls reported as much enjoyment of the task as boys did.

One aspect of the situation, however, has not changed. The contribution of boys to the success of the group continues to be evaluated more highly than that of girls. There is also a slight and almost significant trend for boys to evaluate their own contributions to the success of their groups more highly than do girls. In other words, cultural and/or subcultural changes seem to be making it more permissible for girls to participate in and enjoy tasks requiring creative scientific thinking, but the contributions of boys are still more highly valued by peers than are those of girls.

In trying to understand the reasons for the changes which have been described herein, several obvious facts should be mentioned. During the period in which the data were collected national interest has been focused on the need for identifying and developing creative scientific talent. There is little doubt in my mind that attitudes in general have become more favorable towards science and scientists. It should also be reported that the author discussed with the teachers and parents of the subjects some of the results of earlier studies concerning sex differences in creative thinking. In these discussions, he assumed the position that there is misplaced emphasis or overemphasis on sex roles during the early school years and that this interferes with the development of the creative thinking abilities.

It seems clear that cultural emphasis on sex roles is a source of many conflicts for highly creative individuals and actually interferes with school learning and with the full development of children's creative potential. The high degree of sensitivity involved in creative thinking has a distinctly feminine character in our society; the independence required has a distinctly masculine character. Thus, the highly creative boy is likely to appear more effeminate than other boys his age and the highly creative girl is likely to appear more masculine than other girls her age. Sanctions against such development may cause many children to sacrifice their creativity at an early age. These problems have also been discussed by Frank Barron (1) and Anne Roe (2).

In talks with parents, the author maintained that parents need to recognize that even though they might not want their girls to participate in the tasks of invention and scientific discovery, girls will still need to know much about the physical world. Thus, both boys and girls should be encouraged to talk, ask questions, seek answers, and experiment. There should be no discrimination between boys and girls in the explanations given about how things work. Girls should be taught to be as accurate and keen in their observations as boys. Their questions should be taken as seriously as those asked by their brothers. It is not necessary that this in any way interfere with the boy's learning to be a man and the girl's learning to be a woman.

E. Summary

In 1959 and 1960, a small-group task requiring creative scientific thinking was administered in the fourth, fifth, and sixth grades of a university elementary school. Alternate sets of science toys were used for the tasks and the experiments were conducted at approximately the same time of year (April in 1959 and May in 1960). The 25 members of each class were divided into five five-person groups and each group was tested in a separate room. Twenty-five minutes were allowed for the experimentation and exploration, during which observations were made concerning the initiation of ideas. After a five-minute planning period, 25 minutes were allowed for demonstrations and explanations of scientific principles. During this period observations were made concerning the number of ideas demonstrated and the number of principles correctly explained. At the end, subjects were asked to rank each member of the group, including themselves, on the basis of the value of their contribution to the group's success. In 1960, additional data were obtained concerning enjoyment of the tasks.

Results show that significant changes have taken place in the performance

of girls on this task. In 1959, boys demonstrated and explained significantly more principles than did girls. In 1960, the performance of girls equalled that of boys. The contributions of boys, however, continued to be valued more highly than those of girls. Girls, however, reported as much enjoyment of the task as did boys. The tendency of boys to evaluate their own performance more highly than girls is consistent but does not quite reach statistical significance.

References

1. Barron, F. Originality in relation to personality and intellect. *J. Personal.*, 1957, **25**, 730-742.
2. Roe, A. Personal problems and science. In C. W. Taylor (Ed.), *The Third University of Utah Research Conference on the Identification of Creative Scientific Talent.* Salt Lake City: Univ. Utah Press, 1959.
3. Torrance, E. P. Explorations in creative thinking in the early school years: V. An experimental study of peer sanctions against highly creative children. Minneapolis: Bureau of Educational Research, Univ. Minnesota, 1959.
4. Torrance, E. P. Sex-role identification and creative thinking. Minneapolis: Bureau of Educational Research, Univ. Minnesota, 1959.
5. Torrance, E. P. Explorations in creative thinking in the early school years: A progress report. In C. W. Taylor (Ed.), *The Third University of Utah Research Conference on the Identification of Creative Scientific Talent.* Salt Lake City: Univ. Utah Press, 1959.
6. Torrance, E. P., & Bowers, J. E. Explorations in creative thinking in the early school years: III. Sex roles and appropriateness of stimuli. Minneapolis: Bureau of Educational Research, Univ. Minnesota, 1959.

Bureau of Educational Research
University of Minnesota
Minneapolis 14, Minnesota

The Journal of Genetic Psychology, 1963, **102**, 225-229.

EFFECTS OF RADIATION EXPOSURE ON RESPONSE LATENCIES OF RHESUS MONKEYS*

Department of Psychology, University of Texas

A. A. McDowell, W. Lynn Brown, and J. E. Wicker

A. Problem

A decrease in the locomotor activity of rhesus monkeys exposed to X-radiation has been reported by Harlow and Moon (1) and by McDowell, Davis, and Steele (8). In addition, the frequency of locomotor responses of male rhesus monkeys exposed to a mixed gamma-neutron source was found by McDowell (2) to be less than that of normal male monkeys approximately one year after the cessation of the repeated exposures of the irradiated *S*s.

McDowell (3) has suggested that other response rates may vary in a fashion similar to variation in rates of locomotor activity and that, in consequence, exposure to radiation may lengthen response latencies in the instrumental conditioning paradigm.

The present study proposed to test an hypothesis of lengthened response latencies for irradiated monkeys in an instrumental conditioning situation. Because it was recognized that the greater distractibility (2) and wider scope of attention (9) of the normal monkey may militate against the elucidation of response latency differences in the presence of novel stimuli, response latencies were studied in both familiar and novel stimuli situations.

B. Methods

1. *Subjects*

Sixty-four rhesus monkeys, ranging in age from 40 to 52 months, were used as *S*s. Fifty-six of the *S*s had been exposed to nuclear radiations at the Nevada Test Site approximately 32 months before the present study was initiated. The number of *S*s of each sex in each subgroup and the radiation dosages for the *S*s of each subgroup are shown in Table 1. For the purposes of the present study, the *S*s of the control group and of radiation subgroups I and J constituted radiation dosage group 1, the *S*s of radiation subgroups F, G, and H constituted radiation dosage group 2, and the *S*s of radiation

* Received in the Editorial Office on May 17, 1961.

TABLE 1
DOSE LEVELS FOR AND NUMBER OF Ss OF EACH SEX IN EACH SUBGROUP

Subgroup	Gamma (r)	Neutron (rep)	Estimated total dosage (rem)	No. of males	No. of females
C	252	209	670	5	1
D	242	183	608	4	1
E	204	154	512	5	3
F	187	126	439	3	4
G	169	114	397	5	3
H	151	102	355	3	4
I	129	85	299	6	2
J	119	77	273	5	2
Control	0	0	0	3	5
			Total	39	25

subgroups C, D, and E constituted radiation dosage group 3. In other words, the present study deals with a relative rather than an absolute dosage variable.

All *S*s had initially experienced Wisconsin General Test Apparatus (WGTA) adaptation training (7) and, then, were tested, in successive order, on reduced-cue discrimination problems (6), the spatial delayed-response task (6), dot discriminations (4), and peripheral cue discrimination (5).

2. *Apparatus*

The testing was conducted in a modified version of the WGTA, the holding cage of which measured 36 × 30 × 24 inches. The spatial separation between the two extreme food wells on the stimulus tray was 12 inches. Two wooden blocks which differed in multiple dimensions served as test objects.

3. *Procedure*

During preliminary training, one of the two wooden blocks and the center food well of the three food well test tray were used. Raising the forward opaque screen activated a clock. The clock stopped when the *S* pushed the wooden block from over the food well. Preliminary training consisted of 10 trials per day over a five day period.

After preliminary training, each *S* was tested for 10 trials per day over a five-day period on response latency to the same food-rewarded wooden block placed randomly over either of the two extreme food well positions and, then, for 10 trials per day over a five-day period on response latency to either the same food-rewarded wooden block or to the second non-food-rewarded wooden block presented simultaneously.

Response latency was recorded on each trial. The dependent variable

utilized for statistical analysis was the S's median response latency for the S's trials of testing under each condition.

C. Results

Figure 1 shows the mean median response latency for the Ss of each radiation dosage group under each condition of testing. Statistical analysis of the response latency data on which Figure 1 is based, using a mixed type non-

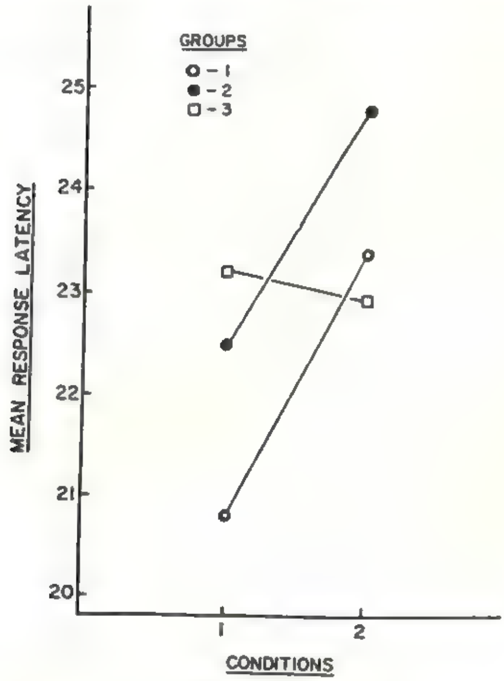

FIGURE 1
Mean Median Response Latency for the Ss of Each Radiation Dosage Group Under Each Condition of Testing

orthogonal analysis of variance procedure, yielded a conditions effect which was beyond the .001 significance level and a radiation groups by conditions interaction which was beyond the .025 significance level. On the single stimulus block condition, the higher the relative radiation dosage the longer the response latency. When the novel nonrewarded stimulus block was introduced, however, the higher the relative radiation dosage the less the disruption of response latency.

D. Discussion

The data of the present study are in direct support of an hypothesis of lengthened response latencies for irradiated monkeys in an instrumental conditioning situation. When the *S*s of the study were presented with a single-object, randomized-position condition, the higher the relative radiation dosage the longer the response latency.

The data also suggest that radiation differences in response latency may be masked by the decreased distractibility of irradiated *Ss*. Presentation of a novel nonrewarded stimulus block with the familiar food-rewarded stimulus block produced the greatest disruption of response latencies for the "low-dose" *S*s and the least for the "high-dose" *Ss*. The "high-dose" *S*s, in fact, continued to respond as they had in the single-object, randomized-position condition.

It appears, then, that radiation exposure slows the rate of response and, at the same time, affords compensation by delimitation of the sample to which the organism responds. The consequence of such radiation effects for performance would, of course, be decremental, nonexistent, or facilitative depending on the requirements of the specific performance situation.

E. Summary

Thirty-nine male and 25 female rhesus monkeys, ranging in age from 42 to 54 months, that had previously been exposed to varying dosages of nuclear radiations, were tested in a modified version of the WGTA for 10 trials per day over a five day period on response latency to a familiar food-rewarded wooden block placed randomly over either of the two extreme food well positions and, then, for 10 trials per day over a five day period on response latency to either the same food-rewarded wooden block or to a novel nonrewarded wooden block presented simultaneously. The following results were obtained.

1. On the single stimulus block condition, the higher the relative radiation dosage the longer the response latency.

2. When the novel nonrewarded stimulus block was introduced, the higher the relative radiation dosage the less the disruption of response latency.

References

1. Harlow, H. F., & Moon, L. E. The effects of repeated doses of total-body x-radiation on motivation and learning in rhesus monkeys. *J. Comp. & Physiol. Psychol.*, 1956, **49**, 60-65.

2. McDowell, A. A. Comparisons of distractibility in irradiated and nonirradiated monkeys. *J. Genet. Psychol.*, 1958, **93**, 63-72.

3. ———. Transfer by normal and chronic whole-body irradiated monkeys of a single learned discrimination along a peripheral cue gradient. *J. Genet. Psychol.*, 1960, **97**, 41-58.
4. McDowell, A. A., & Brown, W. L. Sex and radiation as factors in learning performance by rhesus monkeys on a series of dot discrimination problems. *J. Genet. Psychol.*, 1962, **101**, 273-278.
5. ———. Sex and radiation as factors in peripheral cue discrimination. *J. Genet. Psychol.*, 1963, **102**, 225-229.
6. McDowell, A. A., Brown, W. L., & McTee, A. C. Sex as a factor in delayed-response and reduced cue discrimination learning by previously irradiated monkeys. *J. Genet. Psychol.*, 1962, **100**, 325-329.
7. McDowell, A. A., Brown, W. L., & Wicker, J. E. Some effects of nuclear radiation exposure on preliminary WGTA training performance of rhesus monkeys. School of Aviation Medicine, USAF, Report No. 53-59.
8. McDowell, A. A., Davis, R. T., & Steele, J. P. Application of systematic direct observational methods to the analysis of the radiation syndrome in monkeys. *Percept. & Motor Skills.*, 1956, **6**, 117-130.
9. Overall, J. E., & Brown, W. L. Narrowing of attention as a chronic effect of sublethal radiation. School of Aviation Medicine, USAF, Report No. 27-58.

Department of Psychology
University of Texas
Austin, Texas

The Journal of Genetic Psychology, 1963, **102**, 231-244.

FACTOR ANALYSIS OF THE MERRILL-PALMER AT TWO AGE LEVELS: STRUCTURE AND COMPARISON*

Institute of Child Development and Welfare, University of Minnesota

John G. Hurst

A. Introduction

Though frequently discussed and alluded to, the dimensions of the intellect of the preschool child, as defined by present tests, have seldom been the subject of research. Although the controversies centering around the dimensions (factorial structure) of test-defined intellectual behavior in older children and adults have not been completely resolved, the work at these later ages seems to have several implications for earlier ages. Particularly, the factored theoretical structures of the intellect—e.g., Guilford (6, 7)—at later ages poses both theoretical and practical questions for child psychology. First, what is the dimensionality of intelligence test behavior over the total age range? Second, in what way and to what extent do the dimensions evidence fission and fusion as a function of age? Third, can an adequate theory be developed that will concisely prescribe the construct of intelligence's domain of definition and account for its relationships with other behaviors at all points in the age span? Fourth, can an efficient measure of this behavioral domain in the child be constructed? A comprehensive review of the literature pertaining to some of these questions can be found in a recent article by Meyers and Dingman (10).

The studies reported in this paper are part of a larger project designed to provide information about these questions with predominant emphasis on the preschool age range. Specifically, the purpose of the studies reported here was (*a*) to determine the factorial structure of the Merrill-Palmer (11) when used with a group of three-year-old and a group of four-year-old nursery school children of above average intelligence; and (*b*) to make a quantitative comparison between the factors found at the three-year level and those found at the four-year level. The results will be discussed as they relate to the structure and development of intelligence as defined by current intelligence tests.

* Received in the Editorial Office on May 25, 1961.

B. Method

Two groups of Merrill-Palmer test records were taken from the files of the Institute of Child Development and Welfare. Sample A consisted of tests given to 100 children with a chronological age range of 36 to 42 months; sample B consisted of 234 tests given to children with a chronological age range of 49 to 55 months. Each test record was complete in all respects and had been administered by a staff member or under the direct supervision of a staff member. A descriptive summary of the samples is presented in Table 1.

TABLE 1
Summary Data on Samples

	Boys (*N* 49)			Girls (*N* 51)			Total (*N* 100)		
Sample A	Range	σ	*M*	Range	σ	*M*	Range	σ	*M*
CA	36-42	2.0	39	36-42	2.2	39	36-42	2.1	39
MA	35-66	7.0	45	35-69	8.3	50	35-69	7.8	47
IQ	86-161	14	112	86-153	12	118	86-161	13	115

	Boys (*N* 113)			Girls (*N* 121)			Total (*N* 234)		
Sample B	Range	σ	*M*	Range	σ	*M*	Range	σ	*M*
CA	49-55	1.7	53	49-55	2.0	53	49-55	1.9	53
MA	24-89	11.2	61	21-90	11.6	63	21-90	11.5	62
IQ	46-151	20.6	116	39-153	21.6	119	39-153	21.1	118

The pass-fail dichotomy was determined for each item in the test separately for each sample using the author's criteria for scoring refused and omitted items (11). Items in each sample that had a pass-fail split of greater than 85-15 or 15-85, or were experimentally dependent on an already selected item, were eliminated in order to control spuriousness in the correlation coefficients. Sixteen items in sample A and 14 items in Sample B satisfied these criteria and were retained for further analysis. A description of these items is presented in Table 2.

A matrix of tetrachoric intercorrelations between all items was computed for each sample. The standard errors of zero order tetrachoric coefficients for sample A ranged between .16 and .24, for sample B between .10 and .17. The size of the standard errors are dependent on sample size and pass-fail dichotomies. The Wherry (12) method of achieving a hierarchical factor solution was applied separately to each sample yielding six factors at the three-year level (Study A) and four factors at the four-year level (Study B). The factors were rotated to maximize simple structure and psychological

TABLE 2
ITEMS INCLUDED IN FACTOR ANALYSES

No.	Description	Time limit	Per cent passing	Per cent refused or omitted
	Study A			
34	Closing Fist and Moving Thumb	n.t.	85	04
35	Counting Two Blocks	n.t.	83	05
37	Copying Circle	n.t.	84	07
52	Button Two Buttons	34"	34	01
54	Opposition of Thumb and Fingers	n.t.	54	13
56	Copying Cross	n.t.	27	08
60	Seguin Form Board	63"	60	00
62	Three Cube Pyramid	7"	59	01
64	Action-Agent	n.t.	49	04
65	Picture Puzzle 1	3"	62	00
66	Picture Puzzle 2	46"	52	01
67	Mare and Foal	150"	54	01
68	Little Pink Tower	17"	50	02
71	Picture Puzzle 3	n.t.	40	02
72	Decroly Matching Game	n.t.	47	05
73	Manikin	n.t.	39	02
	Study B			
56	Copy Cross	n.t.	86	06
62	Three Cube Pyramid	7"	74	02
65	Picture Puzzle 1	3"	83	03
70	Six Cube Pyramid	35"	55	03
71	Picture Puzzle 3	n.t.	80	04
75	Button Two Buttons	23"	42	01
76	Picture Puzzle 2	22"	60	02
82	Copy Star	n.t.	32	12
85	Action-Agent	n.t.	61	01
86	Seguin Form Board	39"	45	00
88	Decroly Matching Game	160"	41	03
89	Little Pink Tower	10"	42	02
90	Mare and Foal	86"	57	03
92	Manikin	n.t.	57	02

meaningfulness while preserving orthogonality. The loadings of the items in each sample on their respective factors are presented in Table 3.

The four factors found in the analysis of sample B were compared with the four most similar appearing factors found in the analysis of Sample A and examined for invariance using Ahmavaara's (1) technique of transformation analysis. This method, though not completely satisfactory, seems to add some clarity to the task of assessing invariance with this type of problem. It is unquestionably superior to visual comparisons between factor analytic studies using the same or similar tests with the same or different populations. The general formula for the comparison matrix in matrix notation is:

$$(1) \quad L = (X'X)^{-1} X'Y$$

TABLE 3

FACTOR LOADINGS AND COMPARISON MATRICES[b]

Study A ($X =$)

Item	I	II	III	IV	V	VI	h^2
52	49	46	00	26	08	—12	54
56	58	07	39	08	04	05	50
60	48	30	02	46	10	08	49
62	37	13	—09	12	66	—10	62
64	28	51	05	18	08	17	40
65	54	—06	—02	55	25	—05	66
66	54	—01	08	15	—04	55	61
67	39	58	02	50	—04	10	75
73	16	51	32	09	10	08	41
68	60	00	10	22	—03	—04	42
71	30	09	06	37	05	85	96
34	26	27	10	—12	64	18	61
35	27	46	50	00	00	20	57
37	69	—13	60	06	11	00	84
54	32	44	07	07	61	—12	69
72	18	67	19	25	—13	—13	61
k^2/n	19	13	06	07	08	08	61

Study B ($Y =$)

Item	I′	II′	III′	IV′	h^2
75	35	56	—07	16	47
56	54	22	54	21	68
86	35	12	40	17	33
62	44	—02	38	17	37
85	27	—04	61	—06	45
65	33	—04	37	53	53
76	22	06	51	04	31
90	33	35	50	—10	49
92	17	—01	72	00	55
89	42	05	04	34	30
71	49	09	83	00	94
70	51	09	43	01	45
82	20	40	27	15	30
88	50	44	20	—02	48
k^2/n	15	06	22	04	47

	I	II	III	IV	v[a]
I′	(82)	—28	—38	—33	.42
II′	34	(79)	15	50	1.00
III′	18	67	(40)	60	.37
IV′	67	—27	14	(68)	.94

	I′	II′	III′	IV′	v[a]
I	(74)	31	37	46	.74
II	13	(57)	48	—66	.33
III	18	—18	(97)	00	1.13
IV	24	—25	88	(34)	.30

[a] The v column indicates the approximate length of the transformed vectors before normalizing.
[b] Decimal points omitted.

where X is the matrix of the loadings of items in study A on the factors chosen for comparison from study A (only those items which are also present or have close parallels in study B are included); Y is the parallel matrix from study B, with the restriction that the items be in the same order as they or their counterparts are in matrix X. The matrices are shown in Table 3. The resulting L matrix is then normalized by rows so that the factors will be represented by vectors of unit length. The new matrix Ln is the one employed in the comparison. The Ln matrices for the two comparisons are shown at the bottom of Table 3 and represent the linear transformation of the factors originally determined in the one population into the factor space of the other population. The elements of these two matrices can best be interpreted as the loadings of the factors of one study on the factors of the other study.

The estimation of the effect of possible sources of error on the accuracy of the comparisons can be obtained by graphically plotting the elements of the matrix XL against the corresponding elements of matrix Y and similarly with YL against X. If there were no errors (e.g., statistical, normalization, etc.) all of the plotted points would lie in a line bisecting the angle between the coordinate axes. The results of these comparisons are presented in Figure 1.[1]

C. Interpretation and Comparison of Factors

The inference drawn from the factor loadings and the comparison matrices must be made with considerable caution. As loadings get small they account for smaller portions of an item's variance and contain a greater proportion of error variance. The sources of error in the comparison matrices include error from the original factor loadings, from the normalization, from using the same task with different time limits as parallel items in the two studies, and additional statistical errors. It can be seen from Figure 1 that there is considerable dispersion around the bisecting lines for the two comparisons. The greatest portion of this dispersion is probably attributable to the use of tetrachoric correlation coefficients and the relatively small sample used in study A. Though these transformations seem generally adequate the comparisons should be viewed very conservatively. The factors will be discussed and compared in the following paragraphs. A more thorough presentation of the factors found in study A at the three-year level has been reported elsewhere (8).

---

[1] Tables of intercorrelations and residuals have been deposited with the American Documentation Institute. Order Document no. 7434, remitting \$1.25 for 35 mm microfilm or \$1.25 for 6 by 8 inch photocopies.

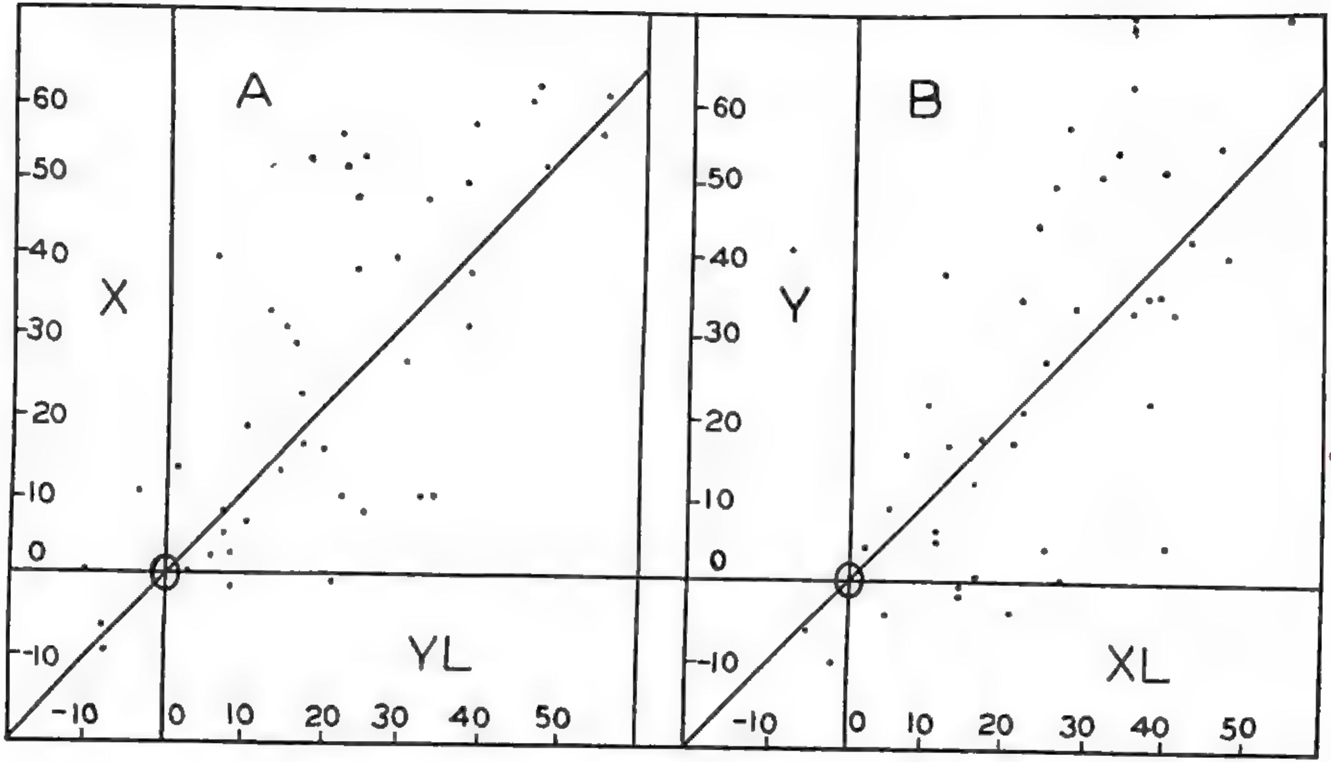

FIGURE 1

GRAPHICAL REPRESENTATION OF THE ACCURACY OF THE COMPARISONS BETWEEN STUDY A AND STUDY B

Plot A represents the accuracy of Ln_1; plot B, the accuracy of Ln_2.

1. *Factors I and I′: Willingness to Cooperate*

Factor I is the dominant factor at the three-year level accounting for 18.3 per cent of the average item variance of study A. It is defined by the following items with loadings of .40 or above:

No.	Loading	Description	Time
37	.69	Copying Circle	n.t.
68	.60	Little Pink Tower	17″
56	.58	Copying Cross	n.t.
65	.54	Picture Puzzle 1	3″
66	.54	Picture Puzzle 2	46″
52	.49	Button Two Buttons	34″
60	.48	Seguin Form Board	63″

Factor I′ is the second most dominant factor at the four-year level and accounts for 15 per cent of the average item variance. With only four negligible loadings this factor is defined by the following items with loadings above .30.

No.	Loading	Description	Time
56	.54	Copying Cross	n.t.
70	.51	Six Cube Pyramid	35″
88	.50	Decroly Matching Game	160″
71	.49	Picture Puzzle 3	n.t.
62	.44	Three Cube Pyramid	7″
89	.42	Little Pink Tower	10″
75	.35	Button Two Buttons	23″
86	.35	Seguin Form Board	39″
65	.33	Picture Puzzle 1	3″
90	.33	Mare and Foal	86″

In the comparison matrices of the transformation analysis (see Ln_1 and Ln_2 in Table 3) we find a fair degree of coincidence between factor I and I′. There appears to be some tendency for factor I to decompose into factor I′ and factor III′ when transformed into the vector space of study B.

The comparison and visual examination of the high loadings on each of these factors provide some confidence in the interpretation of the common elements of these factors at the two age levels. The predominance of timed items and the tasks presented by the nontimed items strongly suggest a rapport or motivation factor rather than one clearly associated with the usual dimensions attributed to the intellect. A poorly motivated subject would be unlikely to put a picture puzzle together in three seconds or to make his best circle or cross. The nonoptimal cooperation involved does not

seem to be obviously manifest in that the examiner would find it difficult to assess at what time and to what extent lack of cooperation contributed to failure on these items. Further discussion and tentative additional evidence supporting the interpretation of factor I and factor II will be found in Hurst (8).

2. *Factors II and II′*

Factor II is the best represented of the factors more commonly identified with the structure of the intellect in study A and accounts for 13.6 per cent of the average item variance. It is defined by the following items with loadings above .40:

No.	Loading	Description	Time
72	.67	Decroly Matching Game	n.t.
67	.58	Mare and Foal	150″
64	.51	Action Agent	n.t.
73	.51	Manikin	n.t.
35	.46	Counting Two Blocks	n.t.
52	.46	Button Two Buttons	34″
54	.44	Opposition of Thumb and Finger	n.t.

Factor II′ accounts for six per cent of the average item variance in study B and is defined by the following items with loadings above .30:

No.	Loading	Description	Time
75	.56	Button Two Buttons	23″
88	.44	Decroly Matching Game	160″
82	.40	Copying Star	n.t.
90	.35	Mare and Foal	86″

3. *Factors III and III′*

These two factors also seem to represent the commonly accepted domain of intellectual behavior. Factor III accounts for 5.8 per cent of the average item variance in study A and is defined by the following items with loadings above .30:

No.	Loading	Description	Time
37	.60	Copying Circle	n.t.
35	.50	Counting Two Blocks	n.t.
56	.39	Copying Cross	n.t.
73	.32	Manikin	n.t.

Factor III′ is the dominant factor at the four-year level (study B) and accounts for 22 per cent of the average item variance. It is defined by the following items with loadings above .30:

No.	Loading	Description	Time
71	.83	Picture Puzzle 3	n.t.
92	.72	Manikin	n.t.
85	.61	Action Agent	n.t.
56	.54	Copying Cross	n.t.
76	.51	Picture Puzzle 2	22″
90	.50	Mare and Foal	86″
70	.43	Six Cube Pyramid	35″
86	.40	Seguin Form Board	39″
62	.38	Thre Cube Pyramid	7″
65	.37	Picture Puzzle 1	3″

4. *Factors IV and IV′: Perceptual Speed*

These factors, though involving relatively small portions of variance, can with some confidence be interpreted as representing perceptual speed. The items with high loadings in both studies are timed and make use of visual configurations. Factor IV accounts for seven per cent of the average item variance in study A and is defined by the following items:

No.	Loading	Description	Time
65	.55	Picture Puzzle 1	3″
67	.50	Mare and Foal	150″
60	.46	Sequin Form Board	63″

Factor IV′, accounting for four per cent of the average item variance in study B, is defined as follows:

No.	Loading	Description	Time
65	.53	Picture Puzzle 1	3″
89	.34	Little Pink Tower	10″

The interpretation and the comparison of the three pairs of factors which seem to most closely resemble the intellectual domain, as usually prescribed, is facilitated by the comparison matrices Ln_1 and Ln_2 presented in Table 3. The computation of two tranformation matrices, one in each direction, provides additional information concerning the consistency and accuracy of the transformation procedure.

It can be observed that factors I and I′, particularly factor I′, show little tendency toward fusion or fission in the comparison matrices. Factor I evidences some fission with a sizeable loading on factor IV′ in study B, the perceptual speed factor. This is probably traceable to the role that speed of response plays in both of these factors where the observed speed is attributed to at least two components: willingness to respond and perceptual speed. This relative independence of factors I and I′ from the other factors further supports their apparent separability from the intellectual domain.

In contrast to factors I and I′ there is a much greater tendency for the remaining factors to evidence fission and fusion. Factor II in study A tends to separate into factor II′ and III′ with a reciprocal relationship with factor IV′ in study B. Factor II′, on the other hand, is accounted for almost entirely by factor II in study A. Factor III in study A is quite consistent with factor III′ in study B. Factor III′ evidences considerable fission when represented in study A with its components loading of factors II, III, and IV. Factor IV tends to fuse with factor III′ in study B. The only pattern apparent in the fusion and fission of these factors is the tendency for the factors accounting for relatively large portions of the common variance in one study to separate into several components when transformed into the vector space of the other study.

The constellation within the comparison matrices suggests that the indeterminacy of the rotations in the two studies may play an important role in the fission and fusion of these factors. However, additional rotations in light of the comparison matrices did not result in a markedly greater degree of invariance. The nature and structure of the Merrill-Palmer scale seems to be in part responsible for the invariance and vagueness obtained. The scale does not contain a sufficient number of items which represent the entire breadth of the intellectual domain as it is outlined in the various multi-factor approaches with older children and adults. This becomes very evident when in order to perform an appropriate factor analysis one must select only those items in a given age range which have a satisfactory pass-fail dichotomy and are not experimentally dependent. Two aspects of the scale tend to restrict the available item pool; first, the use of the same items at several age levels with only a change in the criteria for success (i.e., shorter time limits or an increased number of identifications, matchings, etc.), and second, the original item selection procedure for the scale implicitly emphasized item-total test relationships and thus the selection on the basis of the dominant factor. These mechanical aspects of the scale's construction operate to minimize the potential linear independence and experimental independence among the

items, and thus to limit the number of factors represented and to make it difficult to separate out those that are present.

The interpretation of these factors in terms of psychological dimensions must be vague and tentative because of the fission and fusion that they present. Using the structure proposed by Guilford (6, 7) the elements held in common by factors II and II′ seem to fit into the cognitive domain primarily in the area of finding relations rather than in the area of general reasoning (finding patterns). Factor II which accounts for the major portion of the variance reflecting the intellectual domain in study A appears to represent a composite of the more commonly identified intellectual factors as evidenced by its separation into several components when transformed into study B. This is portrayed with some clarity when we observe the shift of the action agent item, an item which has repeatedly shown significant correlations with later status on intelligence tests. The action agent item which has its most significant loading on factor II in study A appears in study B with its highest loading on factor III′. The communality shared by factors III and III′ seems to represent the often identified factor of spacial visualization (4). Factor III′ which is the dominant factor in study B also seems to be a composite factor in that it separates into several components when transformed into the vector space of study A. Factor III seems to represent a more restricted aspect of the intellect (spacial visualization) than factor III′ which incorporates not only this restricted domain but also parts of the represented domains by factors II and IV. Factors IV and IV′ which are represented in both studies by tests with time limits, especially factor IV′ where relatively short time limits are involved, seem to represent the commonly identified factor of perceptual speed. Factor IV in addition reflects an aspect of factor III′ probably not associated with perceptual speed, whereas factor IV′ probably shares a speed component with factor I.

5. *Factor V: Fine Motor Coordination*

This factor accounts for eight per cent of the average item variance in study A and is defined by the following items:

No.	Loading	Description	Time
62	.72	Three Cube Pyramid	7″
34	.64	Close Fist and Move Thumb	n.t.
55	.61	Opp. of Thumb and Finger	n.t.

A fine motor coordination factor did not appear in the four-year study, primarily because two of its major defining items did not meet the pass-fail criterion for inclusion in study B. It might be further pointed out that since these items did not meet the criteria they had relatively little influence on the general level of performance of the four-year-olds in the sample used in study B, but since this was a relatively superior group these items might be more influential in a average four-year-old sample. This finding seems to be consistent with previous findings concerning the presence and decline of the influence of motor factors in intelligence tests for younger children.

Factor VI in study A will not be interpreted or discussed here because of its relatively small variance, lack of a parallel factor in study B, and doublet characteristics.

D. Discussion

The general structure of the factors in study A and study B are similar enough so that the more extensive discussion of this aspect of the Merrill-Palmer scale with respect to study A remains appropriate (8). Study B adds supporting evidence to the points made previously which were briefly as follows: (*a*) in spite of implicit internal consistency requirements the variance of the Merrill-Palmer at these age levels and with these samples cannot be explained by a general factor, but rather several group factors are necessary; (*b*) large portions of the common variance in the two studies represent factors which are not usually included in definitions of the intellectual domain (e.g., "Willingness to Cooperate" and "Fine Motor Coordination"); (*c*) the poor relationships that have been found between performance on intelligence tests at early ages and performance on intelligence tests at later ages can be at least in part attributed to the presence of the contaminating factors, rather than primarily being a function of the assumption of a changing nature and composition of the intellect within the individual (2).

The differences in the factor composition of the two studies offers some tentative interpretations. These studies, in agreement with recent studies of Cohen (3), do not support a theory of intellectual differentiation as a function of age and experience from a unified general ability (5). There were several factors found at both the three-year and four-year level, with actually fewer factors emerging from the four-year-old group. The composite nature of some of the intellectual factors seems to be more closely related to the nature of the test items and the procedures involved in their selection for inclusion in the test, as indicated in the discussion of the comparisons, than to any unified general ability. The fission of the factors did not evidence

any consistent directional tendencies. The shift of the componets of the major composite factors (II and III′) from study to study, seems to augment an artifactual interpretation of the grouping of their content and the change in the grouping from study to study.

The presence of several factors at these age levels and the strong possibility that the apparent composite nature of some of these factors can best be explained in terms of test characteristics rather than in the nature of the underlying behaviors seems to imply that: (*a*) the structure of the intellect at these age levels and for these samples as defined by the Merrill-Palmer is complex and multidimensional; (*b*) the factor analysis of an appropriate range of item types chosen with respect to the intellectual domain as presently defined by multiple factor tests for adults should result in a more distinct separation of these dimensions in the preschool age range considered in this paper.

It is planned in later studies: (*a*) to control more adequately sample parameters; (*b*) to check the amount and nature of invariance or change within an age group as compared to that between age groups; and (*c*) to use a wider variety of test items.

E. Summary and Conclusions

This paper reports the factor analyses of the performance of an above average group of three-year-old nursery school children and a similar group of four-year-olds, and the results of a quantitative comparison of the two analyses. The technique of comparison used was the method developed by Yrjö Ahmavaara (1).

Six factors were found at the three-year level and four at the four-year level. Factors suggestive of functions other than those usually included in the domain of definition of the concept of intelligence were found at both age levels (e.g., "Willingness to Cooperate" and "Fine Motor Coordination"). These results suggest a multidimensional hypothesis concerning intellectual processes, as defined by the Merrill-Palmer scale, at these age levels and with these samples, rather than a unidimensional one.

The comparison between the two studies suggested that the factors were in general rather loosely structured at each age level and were quite variant. The loose and composite nature of these factors seems to be most parsimoniously explained by the test's mechanical characteristics rather than in terms of the functional unities of the behavioral domains sampled. The only age trends apparent in the findings were the disappearance of a motor factor at the four-year level and a decline in the relative influence of the "Willing-

ness to Cooperate" factor with increased age. These findings do not support a "differentiation" hypothesis concerning the development of intelligence, as defined by performance on the Merrill-Palmer scale.

The results suggest an approach to the development of a preschool intelligence test that would yield scores on several independent factors and minimize the influence of factors not usually considered within the behavioral parameters of the concept of intelligence. Theoretically this test should lead to a significantly improved prediction of later performance on tests designed to measure the same or similar factors or composites of these factors. This test would require a precise delineation of the parameters and structure of the behavioral domain to be labeled "intelligence" (10).

References

1. Ahmavaara, Y. Transformation analysis of factorial data. *Ann. Acad. Sci. Fenn.*, 1954, Ser. B. **88**, 2.
2. Bayley, N. On the growth of intelligence. *Amer. Psychologist*, 1955, **10**, 805-818.
3. Cohen, J. The factorial structure of the WISC at ages 7-6, 10-6, and 13-6. *J. Consult. Psychol.*, 1959, **23**, 285-299.
4. French, J. W. The description of aptitude and achievement tests in terms of rotated factors. *Psychometric Monog.*, 1951, No. 5.
5. Garrett, H. E. A developmental theory of intelligence. *Amer. Psychologist*, 1946, **1**, 372-378.
6. Guilford, J. P. Three faces of intellect. *Amer. Psychologist*, 1959, **14**, 469-479.
7. ————. The structure of the intellect. *Psychol. Bull.*, 1956, **53**, 267-293.
8. Hurst, J. G. A factor analysis of the Merrill-Palmer with respect to theory and test development. *Educ. Psychol. Meas.*, 1960, **20**, 519-532.
9. ————. Factors in preschool intelligence tests and the prediction of distal criteria. *Amer. Psychologist*, 1960, **15**, 390 (Abstract).
10. Meyers, C. E., & Dingman, H. F. The structure of abilities at the preschool ages: Hypothesized domains. *Psychol. Bull.*, 1960, **57**, 514-532.
11. Stutsman, R. Mental Measurement in Preschool Children. Yonkers-on Hudson: World Book, 1931.
12. Wherry, R. J. Hierarchical factor solutions without rotation. *Psychometrika*, 1959, **24**, 54-51.

Institute of Child Development and Welfare
University of Minnesota
Minneapolis 14, Minnesota

The Journal of Genetic Psychology, 1963, **102**, 245-255.

THE ACQUISITION OF TRANSITIVITY OF WEIGHT IN FIVE-TO-SEVEN-YEAR-OLD CHILDREN*[1]

Institute for Social Research and University of Oslo, Norway

JAN SMEDSLUND

A. INTRODUCTION

A subject is said to have an elementary notion of transitivity of weight when he is able to infer from the observations "A weighs more than B" and "B weighs more than C" that A weighs more than C; and when he is able to infer from the observations "A weighs the same as B" and "B weighs the same as C" that A weighs the same as C. (Objects A, B, and C being present.) This elementary notion of transitivity, which rests upon the subject's actual observations, should not be confused with the formal concept of transitivity which permits the subject to make inferences from verbally stated, hypothetical premises.

There is no direct evidence as to the average age at which children acquire the elementary notion of transitivity of weight. A study by Piaget and Inhelder (1) reports observations of both seriation of weights and transitive inferences with a variety of techniques. Their selected, published records show large variations from subject to subject in age of mastery of the various procedures and materials. They report no average age for the simplest form of transitive inference with three objects, but judging from the published material, it appears to be somewhere between eight and nine years. A study by Smedslund (2) showed practically a complete absence of elementary transitivity of weight in a group of children between five and seven years.

The present paper is concerned with the processes by which a concept of transitivity of weight is acquired. The investigation of this problem area was initiated in the above mentioned study by Smedslund.

After a pretest of transitivity of weight subjects were presented with three objects (A, B, and C) and were asked to weigh A and B, and then B and C on a balance, following which they were asked to predict the outcome of a weighing of A and C, and the prediction was checked on the balance.

* Received in the Editorial Office on June 16, 1961.

[1] This study has been financed by the Norwegian Research Council for Science and the Humanities, and was conducted by the author with the assistance of Mrs. Gudrun Eckblad and Mr. Vidar Hundeide.

The subject was also asked to recall the outcome of each of the comparisons A-B, B-C and A-C, and each recall was checked on the balance. In case of errors the entire recall series was repeated, with renewed controls, until the subject recalled all three comparisons without error. A new set of three objects was then introduced, and so forth. After three sessions on three successive days, with a total of 12 groups of three objects, a posttest was given. The outcome was very definite—not one subject improved noticeably from pre- to posttest. It seemed as if the subjects were caught in an evil circle. In the absence of an initial concept of transitivity of weight, they were unable to grasp the empirical transitivity of the objects even after extensive practice. They simply did not understand the necessary interrelationships between $A > B$, $B > C$ and $A > C$, and could not even see the relevance of the two first comparisons for the prediction of the third one.

In order to explore further the possibilities of producing an acquisition of transitivity of weight, we designed a series of four experiments. Since all four employ identical pre- and posttests they can be conveniently discussed as four conditions of a single experiment. Their rationale may briefly be described as follows:

One group of subjects (T) practiced under the conditions of the previous experiment, with certain modifications intended to maximize the possibilities for learning. These modifications included an increase in the number of practice items from 12 to 15, and the introduction of some items composed of equal objects ($a = b = c$) and some mixed items ($a > b = c$) instead of only items composed of unequal objects ($a > b > c$). This partial change in type of item was based on a presumption that the transitivity of equal objects would be more easily understood than the transitivity of unequal objects. The volumes of the objects in each group were made identical, thus eliminating a prominent and misleading perceptual cue, as the objects in the earlier experiment had had varying volumes.

Another group of subjects (S_1) was given the same items as group T, but with instructions to order the objects in each item according to weight. This procedure of *seriation* was expected to force the question of transitivity on the children in the context of a meaningful problem. Suppose that a child first weighs objects B and C and orders them according to weight $B > C$. Then he compares A and C and finds out that A is heavier. He then has to decide about how to order the three objects and which objects have to be weighed together in order to reach a valid conclusion. It was expected that practice on this task would eventually bring about an understanding of the structure of the relationships among the three objects.

A third group (S_2) was given the same task as group S_1 but with 12 items of four objects each, in six sessions on six successive days. It was expected that distributed practice would facilitate the acquisition of transitivity, and that the inclusion of a fourth object in each item would make the seriation aspect of the task more salient and provocative.

Finally, a fourth group (S_3) was given the same task, the same items and the same schedule as group S_2, but with the balance absent both from the pre- and posttests and from the practice sessions. Since the subjects had to weigh all the objects in their hands, the weight-differences were made clearly perceptible.

It was assumed that since the kinesthetic sensation of weight is the natural core of the weight concept, practice on directly perceived weights should lead to more and faster improvement than practice in the more artificial situation with the balance.

Since practically nothing is known about the acquisition of transitivity of weight, we hoped that these varied approaches would throw some light on the problem and permit the formulation of more specific hypotheses.

B. Procedure

A total of 59 children from several nursery schools in Oslo participated as subjects. The average age was 6;3 and the oldest and youngest children participating were respectively 7;2 and 5;0. The average ages for the four groups were: T—6;2, S_1—6;3, S_2—6;2, S_3—6;6. The experimental sessions were conducted individually with each child, in an isolated room in the nursery school.

1. *Pre- and Posttest*

The following procedure was employed in groups T, S_1, and S_2:

A balance was presented and several objects were weighed in order to familiarize the child with the functioning of the scales. Since this was a very easy problem for practically all the children it also served to increase confidence. Three objects of colored plasticine were presented at one time. The child was asked to place the two objects mentioned under (a) (see table below) on the balance to determine their relative weight. This was repeated with the two objects mentioned under (b). In both cases the child was encouraged to state the results explicitly and the experimenter repeated them. Finally, the two objects mentioned under (c) were placed in front

of the child and the following standard question was asked: "Do you think this one weighs more, do you think they weigh the same, or do you think that one weighs more?" After the answer the child was asked: "Why do you think so?" The experimenter maintained a completely neutral attitude to the child's responses and gave no information as to their correctness.

The items were presented in the order given below. "Weighs the same as" is indicated by "=" and "weighs more than" by ">".

1. Red ball, green sausage, yellow cake. All same volume.
   a. Red ball = green sausage
   b. Green sausage = yellow cake
   c. Red ball and yellow cake.
2. Yellow, blue, and brown balls. All same volume.
   a. Yellow ball > blue ball
   b. Blue ball > brown ball
   c. Yellow ball and brown ball.
3. Red, brown, and orange balls. All same volume.
   a. Red ball = brown ball
   b. Orange ball > brown ball
   c. Red ball and orange ball.
4. Blue, orange, and green balls. Blue ball largest volume, orange ball next-to-largest volume, and green ball smallest volume.
   a. Green > blue ball
   b. Blue ball > orange ball
   c. Green ball and orange ball.

The subjects in group S_3 were not presented with the balance at all. They were first asked to judge the relative weight of several pairs of objects by placing one of each pair in each hand. The differences in weight were very pronounced so that the tasks were easy and served to increase confidence. The procedure and the material were exactly the same as in the other three groups, except that the subject weighed the objects in his hands instead of on the balance. In the three other groups the differences in weight were too small to be directly perceived, but in group S_3 they were made clearly perceptible.

2. *Classification of the Children's Responses*

The children's answers were classified as correct or incorrect, and their explanations were classified into three main categories: *symbolic* (S), *perceptual* (P), and *ambiguous* (A). In addition, a subclass of S-explanations, the *symbolic-logical* (S_L) was distinguished.

The categories were defined as follows: *Symbolic*—all explanations which directly or indirectly refer to previous events in the same test item. Example:

"The yellow weighed less than the blue" or "it went down (in an earlier weighing)." *Symbolic-logical*—all symbolic explanations which contain as premises both the previous comparisons. Example: "The ball weighs more (than the sausage) because it weighed more than the cake, and the cake weighed more than the sausage." *Perceptual*—all explanations that directly or indirectly refer to observable features of the present situation. Examples: "It is bigger," "it is a tiny bit higher," "I can see it." *Ambiguous*—all explanations that cannot be subsumed under the preceding categories. Examples: no answer, "I don't know," "I think so," "because it is heavier."

In a previous report this classification was reported to have a very high intersubjective reliability (4).

3. *Practice Sessions*

a. Group T. The subjects were observed on five successive days. The first day they were given only the pretest, the following three days they went through three practice sessions, and on the last day they were given the posttest.

The procedure of the practice sessions was as follows: Three objects (A, B, and C) were presented together. The child was asked to weigh A and B and was asked to state the relationship explicitly. The child then weighed B and C and the result was again emphasized. Finally, A and C were placed together on the table (with B clearly visible a short distance away) and the standard-question was asked: "Do you think this one (pointing) weighs more, do you think they weigh the same, or do you think that one (pointing) weighs more?"

After the answer the child was permitted to control his judgment by placing A and C on the balance. Then he was asked to recall the result of the comparisons A-B, B-C and A-C, each time with renewed empirical control on the scale. If there were any errors in the recall series the series was repeated until the child made no errors, or until the completion of two recall series in addition to the first compulsory one. This meant that during the experiment no child could make less than 90 empirical controls, and in fact all of them made many more than 100.

The items are presented below. It should be noted that no combinations of form and color are repeated and that the relationship between these variables and weight is randomized. All volumes are equal. The differences in weight were too small to be directly perceived. The objects are made of plasticine. "Weighs the same as" is indicated by "=" and "weighs more than" by ">."

Session I

1. Red ball > green snake
   Green snake > yellow sausage
   Red ball and yellow sausage. S.Q.
2. Brown ring = orange cup
   Blue cross = brown ring
   Orange cup and blue cross. S.Q.
3. Red block > green cross
   Blue cake = red block
   Green cross and blue cake. S.Q.
4. Orange ring = brown snake
   Brown snake = green cake
   Orange ring and green cake. S.Q.
5. Blue sausage > yellow block
   Brown cup > blue sausage
   Yellow block and brown cup. S.Q.

Session II

6. Orange ball = red ring
   Yellow snake > orange ball
   Red ring and yellow snake. S.Q.
7. Green sausage = blue cup
   Blue cup = brown cross
   Green sausage and brown cross. S.Q.
8. Red cake > yellow cross
   Yellow cross = blue snake
   Red cake and blue snake. S.Q.
9. Blue ball > red sausage
   Red sausage > orange block
   Blue ball and orange block. S. Q.
10. Orange cake = brown ball
    Green cup = orange cake
    Brown ball and green cup. S. Q.

Session III

11. Orange snake > yellow ball
    Yellow ball > blue ring
    Orange snake and blue ring. S.Q.
12. Red cup = green ball
    Brown block > red cup
    Green ball and brown block. S.Q.
13. Yellow ring > orange cross
    Orange cross > red snake
    Yellow ring and red snake. S.Q.

14. Red cross = blue block
    Blue block = brown cake
    Red cross and brown cake. S.Q.
15. Yellow cake > orange sausage
    Green block = yellow cake
    Orange sausage and green block. S.Q.

b. Group S_1. As in group T the subjects were observed on five successive days which covered the pretest, three practice sessions and the posttest. Procedure in the practice sessions: the balance, a piece of paper, and the three objects of one item were presented. On the paper was drawn a rectangle with the base three times the length of the short side. The rectangle was divided into three squares, one black, one grey, and one white. The following instructions were given (with certain variations and reformulations in order to insure proper understanding): "We are going to place these three objects on the paper, the heaviest in the black square, the middle one in the grey square, and the lightest one in the white square. If some of them weigh the same, they are to be placed together in the same square. You may now proceed to weigh the objects two at a time and find out where they are to lie." It turned out that all the children understood this instruction immediately and followed it with very few mistakes. After the child had weighed and ordered the objects to his satisfaction, the experimenter asked him to control the weight-relationships on the balance. When errors were discovered, the child's procedures of reorganization were recorded.

The objects in the items were identical with those in the T-group, but the order and combination of weighing were left entirely to the child.

c. Group S_2. The subjects were observed on eight successive days (holidays intervening) which covered the pretest, six practice sessions, and the posttest. Procedure in practice sessions: The balance, a piece of paper and four objects of one item were presented. On the paper was drawn a rectangle with the base four times the length of the short side. The rectangle was divided into four squares, one black, one dark grey, one light grey, and one white. The instructions were analogous to those of group S: "We are going to place these four objects on the paper, the heaviest in the black square, the next-to-heaviest in the dark grey square, the next one in the light grey square, and the lightest one in the white square. If some of them weigh the same they are to be placed together in the same square. You may now proceed to weigh the objects two at a time and find out where they are to lie."

This instruction, like that for group S_1 was immediately comprehended.

When the child had ordered the objects to his satisfaction he was asked to control the order by weighing the objects in pairs: the objects in the black and dark grey squares, the objects in the dark grey and light grey squares, etc. When errors occurred the procedure of reorganization was recorded. As in the two preceding groups the differences in weight were not directly perceptible.

The list of items is given below.

Session I

1. Red ball > green sausage > yellow snake > blue cone.
2. Blue ring > orange block > brown cross > green ball.

Session II

3. Brown sausage > yellow cake > red cross > orange snake.
4. Orange cone > red ring > green block > yellow sausage.

Session III

5. Green cake > brown cone > blue ball > red block.
6. Yellow cross > blue snake > orange ring > brown cake.

Session IV

7. Green snake > brown ball > orange sausage > yellow ring.
8. Blue block > green cross > red cone > orange cake.

Session V

9. Red sausage > orange ball > brown snake > blue cross.
10. Yellow cone > brown block > blue sausage > red cake.

Session VI

11. Orange cross > red snake > yellow block > green ring.
12. Blue cake > yellow ball > green cone > brown ring.

c. Group S_3. The procedure and material in this group were identical to that of group S_2 except that the balance was absent, and that the differences in weight among the objects were clearly perceptible. The subjects weighed the objects in pairs (one in each hand) and ordered them in a rectangle divided into four squares. When they had placed the objects, they tested their order by comparing the objects two at a time as in group S_2.

C. Results

The main results are summarized in Table 1. Increments in number of correct responses are relatively more frequent in group S_3 than in the other groups, which do not differ clearly in this respect. Group S_2 improves less in number of S-explanations than the other groups, which are not clearly

different on this measure. Group S_1 is clearly superior to the other groups in increment in number of S_L-explanations; six of the seven subjects who increased their number of S_L-explanations (all from zero in the pretest) are in group S_1. Group S_1 is also clearly superior to the other groups in the case of decrement in number of P-explanations.

TABLE 1

CHANGES IN NUMBER OF CORRECT ANSWERS (c), SYMBOLIC EXPLANATIONS (S), SYMBOLIC-LOGICAL EXPLANATIONS (S_L) AND PERCEPTUAL EXPLANATIONS (P) IN THE FOUR GROUPS T, S_1, S_2, AND S_3

	Group T				Group S_1				Group S_2				Group S_3			
	c	S	S_L	P	c	S	S_L	P	c	S	S_L	P	c	S	S_L	P
Number of subjects raising their scores	6	6	0	4	6	6	6	0	4	1	1	3	8	5	0	2
Number of subjects with unchanged scores	2	7	16	7	5	9	9	4	9	15	15	8	3	6	11	6
Number of subjects lowering their scores	8	3	0	5	4	0	0	11	3	0	0	5	1	1	1	4

The performance of the subjects in the pretests and in the learning sessions showed a general absence of transitivity.

The subjects who improved from pre- to posttest never changed to complete transitivity, i.e., to four correct answers with S_L-explanations. The transitivity, even of the best subjects in the posttest, was typically *unstable.* After a correct answer with an S_L-explanation there often occurred an incorrect answer and/or an inability to give an explanation.

The performance of the subjects in group S_3 differed in certain respects from the subjects in the other groups, who employed a balance. Whereas the S-explanations in the other groups frequently were of the types: "It weighed more than the yellow," "it went down on the scales," "I saw it," the typical S-explanation in group S_3 was "I felt it" (i.e., in my hand).

The subjects in group S_3, although advised to weigh the objects two at a time in the learning sessions, were strongly inclined to take one object at a time, decided which one was the heaviest, then take each of the remaining objects once more, one at a time, and decide which one was the next-to-heaviest, etc. In general they seemed to form "absolute" impressions of the weights, i.e., relative to some internal frame of reference, instead of to the other objects.

D. Discussion

The conditions of groups T and S_1, with closely matched initial performance levels, differed only in the instructions for the practice sessions. Group S_1 was superior in all four measures of improvement, and quite convincingly so in the case of S_L- and P-explanations. The task of seriation of three objects according to weight quite frequently seemed to lead to rejection of the perceptual approach typical of younger children and to the occurrence of instances of genuine transitive inference. The small changes in group T confirmed the negative findings of a previous experiment (2) and support the conclusion that direct practice on transitive inferences with empirical controls does not in general lead to an acquisition of transitivity.

The conditions of group S_2 were similar to those of group S_1 except that there were four, instead of three objects in each item, fewer items and more widely distributed practice. Group S_2 was definitely far behind S_1 on all measures of improvement.

It seems reasonable to attribute this effect to the number of objects to be ordered. Tentatively one may conclude that to order four objects according to weight is too complex a task to permit the development of an understanding of the transitivity of weight relationships. It seems reasonable to assume that such understanding is first developed in the simple case of three objects, and then gradually generalized.

The results of group S_3 seem relatively easy to interpret. Since they tended to give "absolute" judgments based on the "feel" of the single objects, the posttest was merely a second presentation of the same objects. They seemed to compare the remembered "feel" of A and C directly, without any intervention of object B at all. This means that it was possible for them to know that A is heavier than C, without any notion of transitivity. The result was that there was no pronounced cognitive conflict and that they did not acquire transitivity. The improvement in number of correct answers seemed to be a mere effect of the practice in judging weights and the increments in S-explanations were all of the type "I felt it," i.e., not indicating any notions of transitivity.

It may be concluded that only the conditions of group S_1 suggest a promising way of inducing transitivity of weight in children of this age. In general, one may assume that there are two general requirements for an efficient procedure: First, it must induce a moderate amount of cognitive conflict that will engage the child in attempts to understand. Second, the probability of arriving at a solution, i.e., at the required cognitive reorganization, should be relatively high and this is usually the case if the change is relatively small.

This is not a theory in any exact sense, but given specific information about the subject and the situation it has definite implications. Probably the children in group S_1, in attempting to order the objects, are stimulated and provoked by the frequent uncertainties as to where an object should be placed in the row. The intellectual efforts to organize the available information have a greater chance of succeeding when there are only three objects than when there are four. For an overview of some theoretical problems of cognitive development see Smedslund (3).

As to the next step, it might be worthwhile to study whether the insertion of the procedure of group S_1 in a context more meaningful to the child would lead to more improvement. This might be the case if the objects of plasticine were substituted by small dolls, and the balance by a small seesaw. These objects would be close to the subjects' everyday experiences.

E. Summary

The paper is concerned with the problem of how an elementary concept of transitivity is acquired. Four procedures were tried. Group T practiced directly on transitive inferences, i.e., on predicting from "A weighs more than B" and "B weighs more than C" the relationship between A and C, and checking the predictions on a balance. Group S_1 practiced on ordering three objects in a series according to weight, with the help of a balance. Group S_2 worked under the same instructions as group S_1, but with groups of four objects. The subjects in group S_3 ordered four objects in a series, as in group S_2, but without the balance, weighing the objects in their hands. Only group S_1 showed definite signs of acquisition of transitivity, and it was concluded that the task of ordering three objects in a series, by means of a balance seems to be the most effective one in bringing about cognitive conflict and successful cognitive reorganization.

References

1. Piaget, J., & Inhelder, B. Le Développement des Quantités chez l'Enfant. Neuchatel & Paris: Delachaux & Niestlé, 1941.
2. Smedslund, J. Apprentissage des notions de la conservation et de la transitivité du poids. *Études d'Épistémol. Génét.*, 1959, **9**, 85-124.
3. ———. The acquisition of conservation of substance and weight in children. I. Introduction. *Scand. J. Psychol.*, 1961, **2**, 11-20.
4. ———. The acquisition of conservation of substance and weight in children. II. External reinforcement of conservation of weight and of the operations of addition and subtraction. *Scand. J. Psychol.*, 1961, **2**, 71-84.

Institute for Social Research
Munthes Gate 31
Oslo, Norway

The Journal of Genetic Psychology, 1963, **102**, 257-260.

ADJUSTMENT TO FOOD DEPRIVATION CYCLES AS A FUNCTION OF AGE AND PRENATAL X-IRRADIATION*[1]

University of Tennessee

R. Stephen Tacker and Ernest Furchtgott

A. Problem

Reid and Finger (8) reported that rats placed on a 23-hour food deprivation cycle show losses in body weight for at least 35 days. Their seven *S*s were approximately 150 days old at the beginning of the experiment. The authors cogently point out that this type of daily food deprivation schedule is used in many behavioral studies. With the current interest in research on aging it seems worthwhile to ask how adjustment to deprivation is influenced by age. The general problem of the effect of age on hunger drive has not been investigated too throroughly. Margolin and Bunch (6) measured grid crossings in an obstruction box with rats varying in age from 30-40 to 300-350 days. They found that crossings were inversely related to age. However, Botwinick (1) points out that the responses could have been affected, not only by drive changes, but also by changes in locomotion.

The availability of prenatally X-irradiated rats provided the opportunity for the study of an additional problem. Radiobiologists have advanced the hypothesis that ionizing radiations may produce organismic changes which mimic or hasten normal aging processes (9). While most of the early work was done on animals irradiated postnatally, a recent study by Brent and Bolden (2) showed that 100 r administered on the ninth day of gestation shortens the life span of the irradiated rats. So far none of the work in this area has dealt with any behavioral measures.

The purpose of the present study is to investigate the adjustment of rats to food deprivation cycles as a function of age and prenatal X-irradiation. The age levels used go far beyond those previously employed in the study of the effects of age on hunger drive.

B. Procedure and Results

One hundred twenty-three offspring of albino rats originally obtained from the Budd Mountain Rodent Farm were studied. The irradiated subjects

* Received in the Editorial Office on June 19, 1961.

[1] This study was supported by the National Institute of Mental Health, USPHS, under Grant No. M 1064.

received 100 to 200 r *in utero* between Days 14 and 18 of the gestation period. The breeding and irradiation procedures were previously described (3). Table 1 presents the distribution of subjects in terms of sex, age, and their weight at the beginning of deprivation.

TABLE 1
CHARACTERISTICS OF SUBJECTS

Subjects	Males *N*	Weight* gm	Females *N*	Weight* gm	Median age in days	Age range
Irradiated (200 r)	9	402	14	359	679	629-717
Controls	16	537	26	373	677	650-735
Irradiated (200 r)	6	463	6	277	380	380
Controls	5	538	7	326	397	397
Irradiated (100-200 r)	5	306	10	202	94	90-94
Controls	3	224	7	174	75	75

* Mean weight at the beginning of the experiment.

All animals were maintained on a 22-hour deprivation cycle rather than the customary 23-hour period to make certain that they had sufficient time to eat. Water was available *ad lib.*, and the food consisted of dog chow. The subjects were weighed during the twenty-first hour of the deprivation cycle.

The data were analyzed in terms of the changes in the per cent body weight from the predeprivation level ($\frac{\text{weight day X}}{\text{initial weight}} \times 100$). The mean group weights for each third day are presented graphically in Figure 1.

It is quite obvious that adjustment to food deprivation in terms of body weight is slower in older than in younger animals. In all three age groups the irradiated rats lost more weight than the controls. The data were also analyzed separately for the two sexes and essentially the same results were obtained.

C. DISCUSSION

It is well known that the regulation of food intake is controlled by a large number of factors (7). The initial greater weight and excess body fat of the older animals probably accounts for their slower adjustment to the deprivation schedule. Of course, one can also hypothesize that central nervous system (CNS) factors, which play an important role in feeding, are less efficient in older subjects. However, this is a rather tenuous hypothesis in the absence of well-defined CNS changes with age.

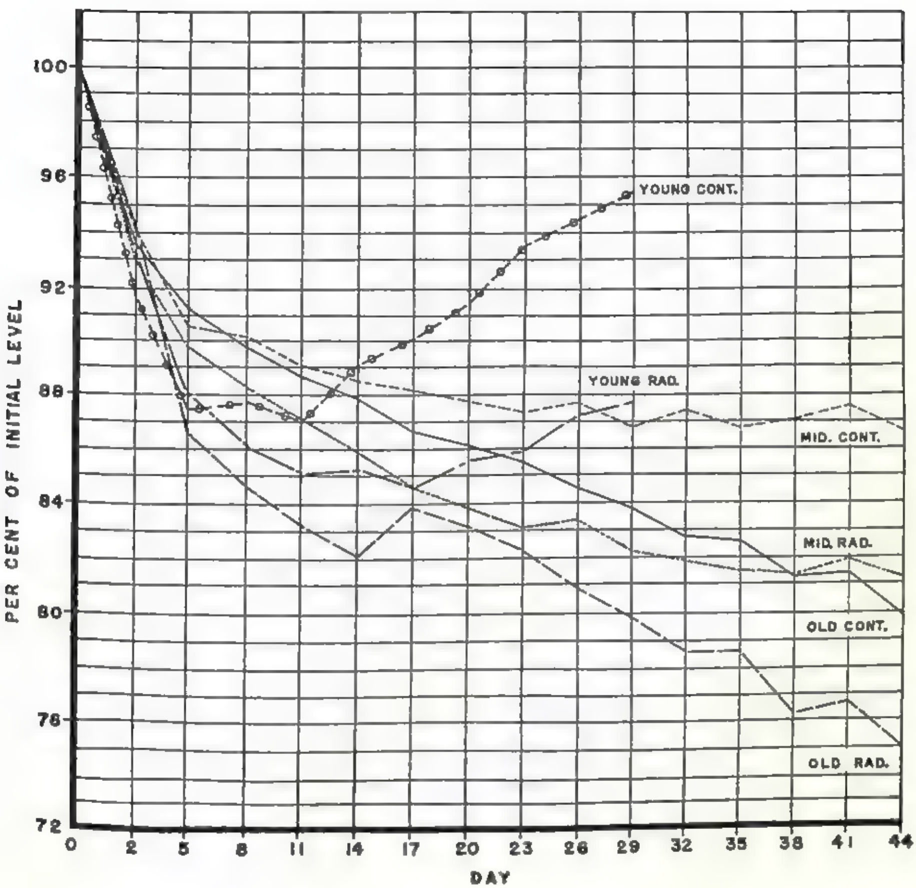

FIGURE 1
MEAN BODY WEIGHTS OF YOUNG (MEDIAN AGES 75-94 DAYS), MIDDLE-AGED (MEDIAN AGES 380-397 DAYS), AND OLD (MEDIAN AGES 677-679 DAYS) RATS ON A 22-HOUR FOOD DEPRIVATION CYCLE

The greater loss in body weight and slower adjustment of the irradiated rats at every age level came somewhat as a surprise since in each group they weighed initially less than the controls, and thus it might have been assumed that they had a greater caloric need. Hence it would seem plausible to invoke CNS deficiency as a major factor retarding the animal's adjustment to the feeding regimen. Several studies (3, 4, 5) have demonstrated learning deficits in prenatally irradiated rats. According to this hypothesis the irradiated animals are slower in learning to eat a sufficient amount during the two-hour feeding period, even though they weigh less than control *S*s, and thus their caloric deficit is greater.

It may also be proposed that the irradiation effects mimic aging. The inverse relationship between adjustment to food deprivation and age, and the slower adjustment of the irradiated subjects at every age level would fit the "aging" hypothesis advanced by several radiobiologists (9). It may be regarded as the first behavioral demonstration of a radiation induced "aging-like" phenomenon.

D. Summary

One hundred twenty-three albino rats of both sexes, approximately half of them X-irradiated *in utero* between Days 14 and 18 of the gestation period, were placed on a 22-hour food deprivation cycle. The ages of the *S*s at the start of the experiment varied from 75 to 735 days. Speed of adjustment to the food deprivation, measured in terms of the number of days that body weight losses occurred, was inversely related to age, and at every age level the X-irradiated *S*s adjusted more slowly than the control animals. The latter may be considered as the first behavioral support for the radiobiological theory of aging.

References

1. Botwinick, J. Drive, expectancies, and emotions. In J. E. Birren (Ed.), *Handbook of Aging and the Individual.* Chicago: Univ. Chicago Press, 1959. Pp. 739-768.
2. Brent, R. L., & Bolden, B. T. The long-term effects of low dosage embryonic irradiation. *Radiat. Res.,* 1961, **14**, 453-454 (Abstract).
3. Furchtgott, E., Echols, M., & Openshaw, J. W. Maze learning in pre- and neonatally X-irradiated rats. *J. Comp. & Physiol. Psychol.,* 1958, **51**, 178-180.
4. Graham, T. M., Marks, A., & Ershoff, B. H. Effects of prenatal X-irradiation on discrimination learning in the rat. *Proc. Soc. Exp. Biol. & Med.,* (N.Y.), 1959, **100**, 78-81.
5. Levinson, B. Effects of fetal irradiation on learning. *J. Comp. & Physiol. Psychol.,* 1952, **45**, 140-145.
6. Margolin, S. E., & Bunch, M. E. The relationship between age and the strength of hunger motivation. *Psychol. Monog.,* 1940, **16**, 1-34.
7. Miner, R. W., *Ed.* The regulation of hunger and appetite. *Ann. N.Y. Acad. Sci.,* 1955, **63**, Art. 1.
8. Reid, L. S., & Finger, F. W. The rat's adjustment to 23-hr. food deprivation cycles. *J. Comp. & Physiol. Psychol.,* 1955, **48**, 110-113.
9. Upton, A. C. Ionizing radiation and the aging process. *J. Geront.,* 1957, **12**, 306-313.

Department of Psychology
The University of Tennessee
Knoxville, Tennessee

The Journal of Genetic Psychology, 1963, **102**, 261-265.

SEX AND RADIATION AS FACTORS IN PERIPHERAL CUE DISCRIMINATION LEARNING*[1]

Department of Psychology, The University of Texas

A. A. McDowell and W. Lynn Brown

A. Problem

Murphy and Miller (7) have studied the relation of spatial contiguity of cue and reward to object-quality learning by rhesus monkeys. Their monkeys failed to acquire the necessary discriminations when the stimulus objects were displaced vertically for a distance of six inches from the site of reward. Similar results were obtained by McDowell and Brown (3). Their monkeys failed to resolve a "color" discrimination problem during 750 trials of testing when the discriminanda were displaced in the horizontal-parallel dimension for a distance of 7.875 inches from the site of reward.

The purpose of the present investigation was twofold. First, the investigation sought to determine if rhesus monkeys with less training on direct response to the relevant cue, and younger, than the *S*s previously used by McDowell and Brown could resolve a peripheral cue, "color" discrimination problem. Secondly, in view of previously reported radiation and sex differences in scope of attention (1, 5, 8), the investigation sought to explore these two parameters with respect to this particular learning paradigm.

B. Methods

1. *Subjects*

Sixty-four rhesus monkeys, ranging in age from 40 to 52 months, were employed as *S*s. Fifty-six of the *S*s had been exposed to nuclear radiations at the Nevada Test Site approximately 28 months before the present study was initiated. The number of *S*s of each sex in each subgroup and the radiation dosages for the *S*s of each subgroup are shown in Table 1. For the purposes of the present investigation, the only comparisons considered were between irradiated and nonirradiated *S*s.

All *S*s had previously experienced preliminary Wisconsin General Test Apparatus (WGTA) training (6), testing on reduced-cue discrimination

* Received in the Editorial Office on June 28, 1961.

[1] This work was conducted at the Radiobiological Laboratory of The University of Texas and the United States Air Force, Austin, Texas.

TABLE 1
DOSE LEVELS FOR AND NUMBER OF *S*s OF EACH SEX IN EACH SUBGROUP

Subgroup	Gamma (r)	Neutron (rep)	Estimated total dosage (rem)	No. of males	No. of females
9	252	209	670	5	1
8	242	183	608	4	1
7	204	154	512	5	3
6	187	126	439	3	4
5	169	114	397	5	3
4	151	102	355	3	4
3	129	85	299	6	2
2	119	77	273	5	2
1	0	0	0	3	5
			Total	39	25

and delayed response problems (4), and testing on a series of dot discrimination problems (2).

2. *Apparatus*

All training of *S*s in this investigation was conducted in a modified version of the WGTA, with the carrying cage serving as the holding cage during the test procedure. A modified two-string patterned string board, as shown in Figure 1, was used for the testing.

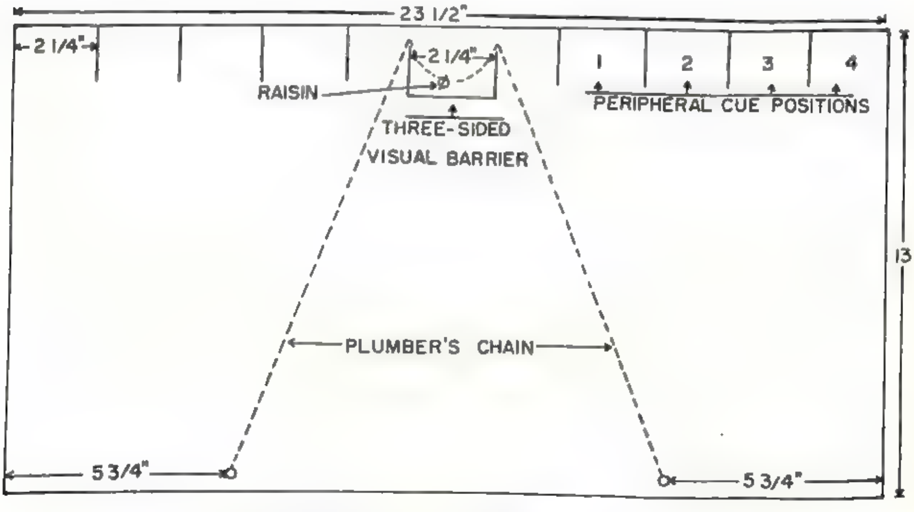

FIGURE 1
THE MODIFIED TWO-STRING PATTERNED STRING BOARD USED FOR THE PERIPHERAL CUE TESTING

The string board was placed directly over the stimulus tray of the WGTA. The "strings," pieces of plumber's chain, were attached at the front of the board to seated eyebolts and extended to behind a three-sided chimney in the rear center of the board. Small nails attached to the free ends of each length of plumber's chain were used to impale the food reward, either a piece of diced apple or a raisin, on the end of the appropriate chain. The three-sided chimney prevented the *S* from response on the basis of seeing which chain held the food reward. The peripheral cues were placed in the rear corners of the string board. The distance from the inner edge of each peripheral cue to the edge of the three-sided chimney was 7.875 inches.

The negative cue was a gray painted square wood block. The positive cue was a red painted square wood block of the same dimensions as the negative stimulus object.

3. *Procedure*

Each *S* was tested 24 trials per day for 48 days. Manual response to the length of chain on the side of the board holding the positive object was consistently rewarded. Over the course of the 24 daily trials position of the positive object was aperiodically, but evenly, varied between the right and left positions.

C. Results

Statistical analysis of the error data for successive eight-day periods of peripheral cue testing, using a nonorthogonal analysis of variance procedure, yielded a practice effect which was beyond the .001 significance level and a radiation-groups-by-sex-by-practice interaction which was beyond the .005 significance level. The nature of the interaction can be seen in Figure 2, which shows the per cent of errors for each sex of both the irradiated and nonirradiated groups over successive eight-day periods of testing. The fastest rate of improvement with practice is shown by the nonirradiated female *S*s, next fastest by the irradiated male *S*s, third fastest by the irradiated female *S*s, and slowest by the nonirradiated male *S*s.

The irradiated male *S*s improved more rapidly with practice than did the nonirradiated male *S*s, but the irradiated female *S*s improved less rapidly with practice than did the nonirradiated female *S*s.

D. Discussion

It is obvious from the results of the present study that rhesus monkeys, if given extended training, can resolve a "color" discrimination problem when the discriminanda are displaced in the horizontal-parallel dimension

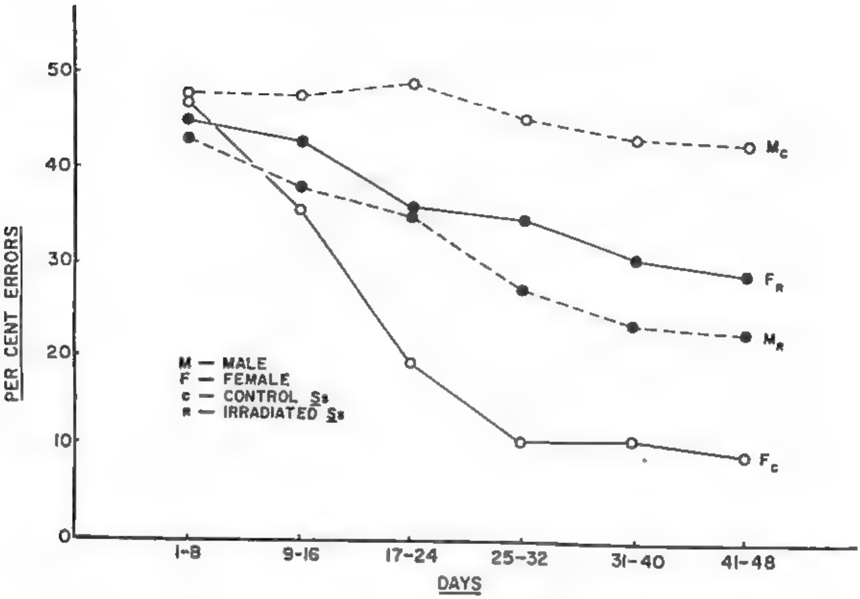

FIGURE 2
PER CENT ERRORS DURING SUCCESSIVE 8-DAY PERIODS OF TESTING FOR THE *S*s OF EACH SEX IN THE IRRADIATED AND NONIRRADIATED GROUPS

for a distance of 7.875 inches from the site of reward. While the disparity between these results and the earlier published results of McDowell and Brown (3) can not be adequately resolved in the context of the present experiment, such a disparity *may* reflect differences in the training histories of the *S*s involved in the two studies. It is, in other words, conceivable that extensive training to respond directly in the contiguous cue-reward situation may reduce response tendencies to peripheral stimuli.

The finding of a significant radiation groups by sex by practice interaction may suggest, at first consideration, that exposure to radiation affects the sexes differently. Previous research, however, has shown that radiation exposure decreases the distractibility of the monkey (1) with a consequent narrowing of attention (8) and that female monkeys show greater focalization of attention than do male monkeys (5). In view of the previous research, the significant triple interaction can be interpreted as reflecting a radiation-induced narrowing of attention for both sexes. Because of the sex differences in attention in normal monkeys, however, the result of this induced narrowing of attention for the male *S*s may be proportionately greater exclusion of irrelevant (peripheral) stimuli whereas, for the female

*S*s, the narrowing must involve, to a greater extent, the relevant (proximal) stimuli.

E. Summary

Thirty-nine male and 25 female rhesus monkeys, ranging in age from 40 to 52 months, that had previously been exposed to varying dosages of nuclear radiations, were tested 24 trials per day for 48 days on a peripheral cue, "color" discrimination problem. Statistical analysis of the error data, using a nonorthogonal analysis of variance procedure, yielded the following results:

1. The practice effect was significant indicating that rhesus monkeys, if given extended training, can learn a "color" discrimination when the discriminanda are displaced in the horizontal-parallel dimension for a distance of 7.875 inches from the site of reward.

2. The radiation groups by sex by practice interaction was significant. For the female *S*s, radiation exposure slowed the rate of improvement with practice. For the male *S*s, however, the converse was true.

References

1. McDowell, A. A. Comparisons of distractibility in irradiated and nonirradiated monkeys. *J. Genet. Psychol.*, 1958, **93**, 63-72.
2. McDowell, A. A., & Brown, W. L. Sex and radiation as factors in learning performance by rhesus monkeys on a series of dot discrimination problems. *J. Genet. Psychol.*, 1962, **101**, 273-278.
3. ———. Some effects of radiation exposure on susceptibility to proactive inhibition by rhesus monkeys. *J. Genet. Psychol.*, 1960, **97**, 251-256.
4. McDowell, A. A., Brown, W. L., & McTee, A. C. Sex as a factor in delayed-response and reduced-cue discrimination learning by previously irradiated monkeys. *J. Genet. Psychol.*, 1962, **100**, 325-329.
5. ———. Sex as a factor in spatial delayed response performance by rhesus monkeys. *J. Comp. & Physiol. Psychol.*, 1960, **53**, 429-432.
6. McDowell, A. A., Brown, W. L., & Wicker, J. E. Some effects of nuclear radiation exposure on preliminary WGTA training performance of rhesus monkeys. USAF School of Aviation Medicine, Report No. 53, 1959.
7. Murphy, J. V., & Miller, R. E. The effect of spatial contiguity of cue and reward in the object-quality learning of rhesus monkeys. *J. Comp. & Physiol. Psychol.*, 1955, **48**, 221-224.
8. Overall, J. E., & Brown, W. L. Narrowing of attention as a chronic effect of sublethal radiation. USAF School of Aviation Medicine, Report No. 27, 1958.

Department of Psychology
The University of Texas
Austin, Texas

The Journal of Genetic Psychology, 1963, **102**, 267-275.

GENETICS, AGE, AND THE VARIABILITY OF LEARNING PERFORMANCES* [1]

Vanderbilt University

Gilbert W. Meier and Donald P. Foshee[2]

A. Problem

The lore of research methodology in psychology cautions the experimenter to be wary of subject variables and, where possible, to use genetic controls in the groups of *S*s chosen for study. Since homozygous twinning is a biological rarity, in mammals at least, this control has been met through the selection of *S*s with identical or near-identical genetic backgrounds. Since the vigor of the use of the split-litter technique for genetic control has been chilled, at least somewhat (4), the current mode is the use of inbred strains for this same end. Unfortunately, geneticists have now raised questions about the nature of genetically homogeneous material, questions which may seriously complicate behavioral researches at those moments when the investigator comes to seek intra- and intersubject reliabilities—when he comes to compare the performance of groups in the hope of estimating the significance of a specified independent variable (1). Some geneticists suggest that the homogeneous *S*s are more variable on polygenic traits, e.g., drug responsiveness and viability, than are their heterogeneous counterparts (2). Some verification of this potentiality for behavior studies is given by Mordkoff and Fuller (3) in their interstrain analyses of activity for inbred and hybrid *S*s alike. The import of this revelation of variability for evaluations of behavior, where polygenic heritability is the rule, may be stupefying.

The intent of this paper is to present additional behavioral data on groups of *S*s, homogeneous and heterogeneous, by way of indication of the relevance of the geneticist's concern for the methodology of the behavioristic disciplines. In order, these data will show the pertinence of these considerations for several strains of *S*s at a specified age on a particular task and, second, the pertinence of these considerations for a pair of strains as related to age at time of testing.

* Received in the Editorial Office on June 29, 1961.

1 This research was supported by a contract (AT-[40-1]-2166) between the Atomic Energy Commission and Vanderbilt University.

2 This investigation was carried out during the tenure of a Predoctoral Fellowship from the National Institute of Mental Health, United States Public Health Service.

B. Study I

1. *Method*

a. Subjects. For the first investigation, 10 male *S*s representing each of six strains of housemice were used for a total of 60 animals. These strains were AKR, BALB/c, C3H/He, C57B1/6, CF/1, and DBA/2. Of these strains only the CF/1 is not highly inbred; it is a random-bred, albino strain but separately maintained for approximately the same number of generations as were any of the others. Selection of the strains was on the basis of recorded differences in longevity. All *S*s were born in the Vanderbilt colony. At the start of testing they were 42 days of age.

b. Apparatus. As a pretraining device a swimway, 48 inches long and six inches wide was used. The water was maintained at room temperature, about 70° F., and at a depth of 14 inches whereupon the surface was six inches from the top of the tank. An escape ramp fashioned of hardware cloth was placed at one end, adjacent to a drying rack.

A simple, three-choice point water maze was the testing device. The general pattern and dimensions are illustrated in Figure 1. The depth of the water was six inches whereupon the surface was three inches from the top of the tank. The temperature of the water was maintained at 60° F. A wire ramp and platform of hardware cloth was placed at the end of the right cul during initial learning. At this time the metal barrier after the first choice point was placed in the right alley. Both the ramp-platform and the barrier were moved to the left during the reversal training.

c. Procedure. On the first day of training *S* was given three preliminary trials on the swimway. The *S* was dropped into one end of the tank and permitted to swim to the wire ramp. Time was recorded from initial immersion to final emergence.

On the first day of testing *S* was given five trials on the three-choice point maze. The *S* was dropped into the maze at the start point and permitted to swim to the wire ramp and drying platform at the right exit cul. This procedure was repeated for four days for a total of 20 trials.

On the fifth day the ramp and platform were moved to the left exit cul. The metal barrier after the first choice-point was moved accordingly. The *S* was given 10 trials, two days of five trials each, for the second or reversal phase of learning.

The *S*s were run in groups of approximately 10 during the mid-day hours. Through all the testing procedures time and error scores were recorded.

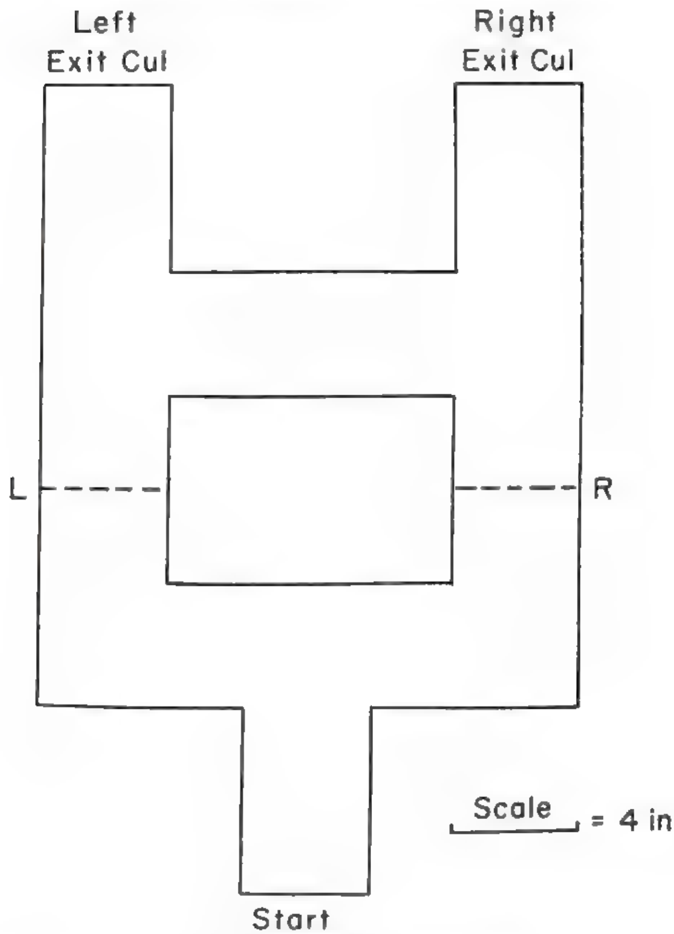

FIGURE 1
Floorplan of the Three-Choice Maze
The ramp platform was placed at either the right or the left exit cul; the barrier was placed at either R or L.

2. *Results*

The results on the six strains of *S*s are presented in Figure 2. In this representation, the means of the median time per day are plotted over the six days of testing—four for initial learning and two for reversal. Clearly, the six strains are divided into two distinct groups—one for high and one for low median times.

To a limited extent these data support the position of increased variance with homogeneity as contrasted to heterogeneity. In this instance the variabil-

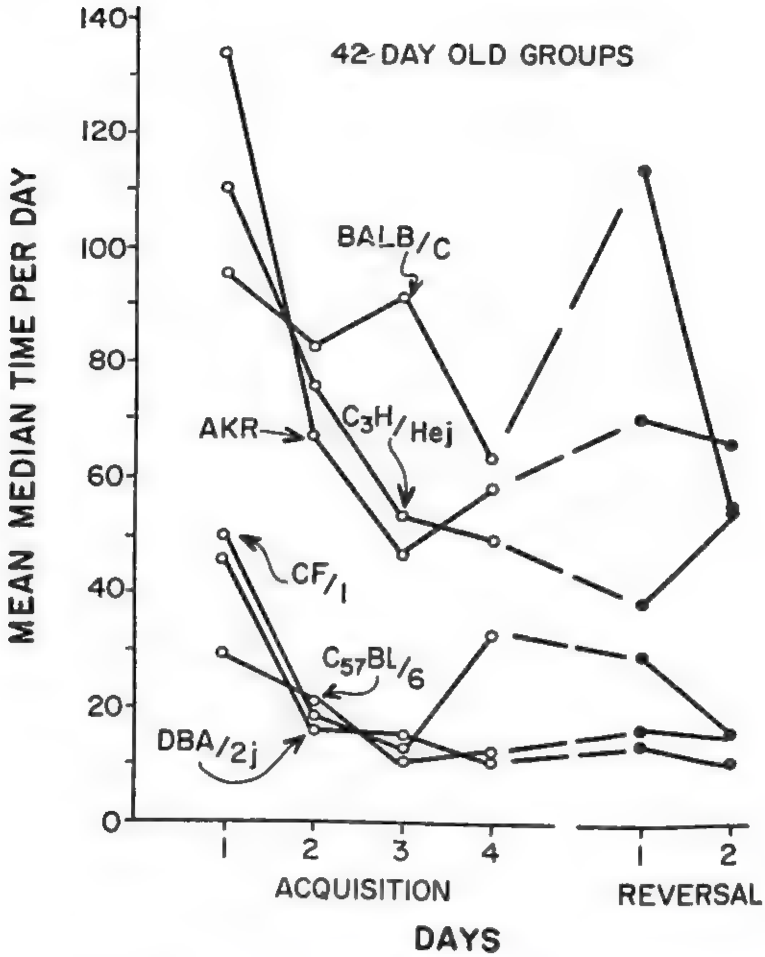

FIGURE 2
REPRESENTATION OF THE MAZE PERFORMANCES, IN TIME SCORES, OF THE SIX STRAINS OF MICE
Both the acquisition and reversal performances are indicated.

ities of the AKR, BALB/c, and C3H strains were greater than the random-bred CF/1 strain. The last, however, could not be differentiated from the other two inbred strains, C57B1/6 and DBA/2; all were low.

Obviously, the means and variances (estimated standard deviations) were correlated. This, however, is the expected outcome under the stipulations of heterosis, i.e., increased vigor and reduced variance.

C. Study II

1. *Method*

a. Subjects. In the second investigation, 10 male *S*s representing each of two strains of housemice at each of seven ages were used, a total of 140 *S*s. The strains used were the BALB/c, an inbred strain, and the CF/1, a random-bred strain. Selection of these strains was on the basis of reputed long longevity and acknowledged high reproductivity. All *S*s were born in the Vanderbilt colony. The ages at the start of training were: 21, 42, 63, 84, 105, 147, and 189 days.

b. Apparatus. Same as for Study I.

c. Procedure. Same as for Study I.

2. *Results*

The results on the two strains at the seven ages are presented in Figure 3. As in Figure 2, the means of median time per day are plotted over the four days of initial learning. The differences in the performance of the

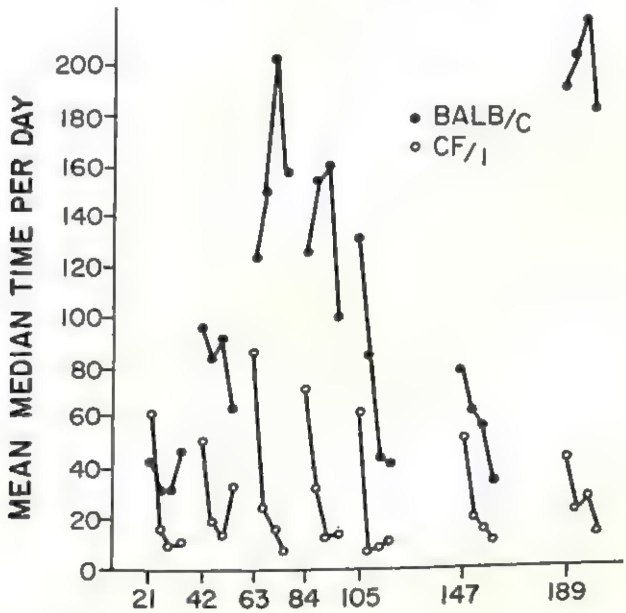

FIGURE 3
Representation of the Maze Performances, in Time Scores, of the Two Strains, BALB/c and CF/1, Over the Seven Ages Tested
Only the acquisition performances are indicated.

ains are especially striking. The behaviors of the homogeneous BALB/c's re as variable over the seven ages as those of the CF/1's were constant.

The increase in means and variances of the BALB/c behavior at the et of sexual maturity and at early adulthood are clearly discernible in gure 4. Only a suggested rise in these measures with adolescence is indied in the CF/1 performances.

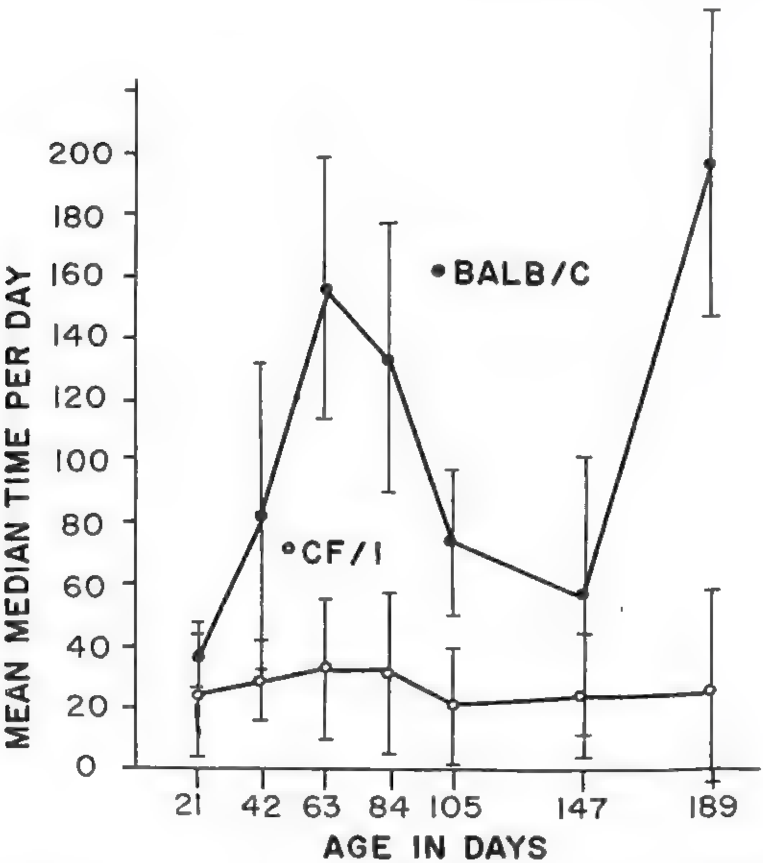

FIGURE 4
Representation of the Median Time Scores of the Two Strains, BALB/c and CF/1, Over the Seven Ages Tested
The estimated standard deviations are indicated by the vertical lines above and ow the performance means.

The depressed learning efficiency of the BALB/c's immediately after ual maturation is indicated, further, in the error scores depicted in

Figure 5. No such relation between efficiency and maturation is intimated in the CF/1 scores.

Throughout, the variances of the BALB/c performances were considerably larger than those of the CF/1 strain. The correlation between means and variances was evident in the BALB/c data but not in the CF/1. In the latter, the learning performances were quite stable across age groups.

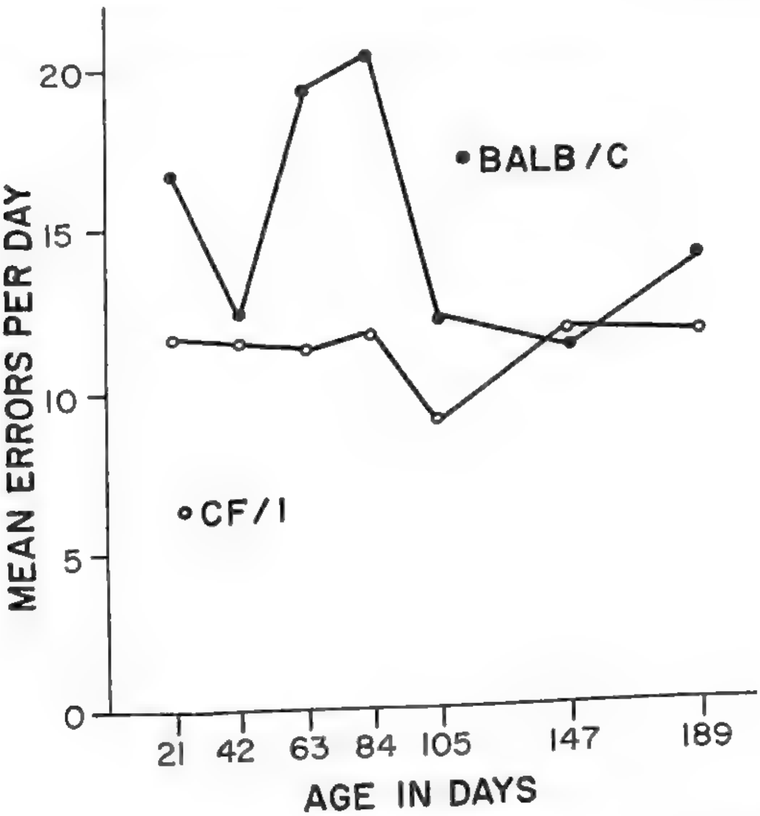

FIGURE 5
REPRESENTATION OF THE MAZE PERFORMANCES, IN ERROR SCORES, OF THE TWO STRAINS, BALB/c AND CF/1, OVER THE SEVEN AGES TESTED

D. Discussion

The results of these two investigations, together, indicate that increased variability of homogeneous strains *may* be as important a consideration for behavior analyses as is is for analyses of drug responsiveness and viability. However, the low variability of two of the inbred strains in the first study

should not be overlooked or, even minimized. Feasibly, this genetic variability is a sometime thing: when absent significant genetic differences or metric difficulties are suggested.

At first glance, the age-related differences in means and variabilities of the BALB/c data are perplexing. However, a more thoughtful consideration of the decrease in behavioral efficiency during adolescence and early maturity in the inbred-strain performance reveals what may be the prime justification for the use of inbred, rather than hybrid or random-bred, forms. If there exists a phenomenon of developmental homeostasis, as hypothesized (1), the relative lack of which characterizes the genetically homogeneous *S* and because of which he is unduly responsive to environmental variations, then the inbred *S* offers considerable research advantage for those investigations in which manipulation of the developmental environment constitutes the independent variable. Research-wise, this advantage may be a sufficient reason-for-being. Nevertheless, the inbred *S* does demand of the investigator concern over the constancy of the rearing and testing environments, whatever they may be, and over the nature of the statistical tools employed. In the present instance, the BALB/c data may be describing a developmental relation in which the laboratory environment and testing procedure are implicated but which is not evident in the CF/1 data due to the greater canalization or physiological buffering in the CF/1, the genetically heterogeneous strain.

E. Summary

Through the past several years the significance and implications of genetic factors for the methodology of behavioral research have been critically reconsidered and reevaluated. The efforts are neither unique to these times nor to this discipline, nor is the consensus original: genetic control via inbred *S*s offers the researcher many real and unmatched advantages. However, other nuances of this genetic issue have been emphasized recently, specifically the interactions with environmental influences expressed in the much greater intersubject, biochemical variability of the highly inbred than of the random-bred or the F_1 hybrid *S*s. The intent of this paper was to demonstrate that this variability has its behavioral counterpart and, further, that it complicated by maturational factors.

Groups of housemice were run on a three choice-point water maze for 30 trials—20 trials for initial learning and 10 trials for reversal learning—at five trials per day. In the first study, comparisons were made of the performances of *S*s representing six strains, inbred and random-bred, tested

at 42 days of age. As expected, the random-bred *S*s were more efficient and less variable than *S*s of three of the inbred strains but comparable to *S*s of the other two inbred strains.

In the second study, comparisons were made of *S*s representing one inbred and one random-bred strain tested at 21, 42, 63, 84, 105, 147, or 189 days of age. Regular learning curves were described by groups of *S*s of the random-bred strain. Contrariwise, the performances of the groups of inbred *S*s were highly variable: expected learning behavior was seen at some ages, but not at others. Intersubject variability increased as the adequacy of the responses decreased, the indicated relation being curvilinear with greatest inefficiency shown during adolescence.

Data such as these are of real concern for the researcher with a penchant for experimental control and a need for intersubject uniformity. However, a palliative is found in the concept of "developmental homeostasis" and the realization that genetically-pure material affords a sensitive indicant, par excellence, of the vicissitudes, controlled or otherwise, of the environment.

References

1. Lerner, I. M. Genetic Homeostasis. New York: Wiley, 1954.
2. McLaren, A., & Michie, D. Variability of response in experimental animals: A comparison of the reaction of inbred, F_1 hybrid, and random bred mice to a narcotic drug. *J. Genet.*, 1956, **54**, 440-455.
3. Mordkoff, A. M., & Fuller, J. L. Heritability in activity within inbred and crossbred mice: A study in behavior genetics. *J. Hered.*, 1959, **50**, 6-8.
4. Ross, S., Ginsberg, B. E., & Denenberg, V. H. The use of the split-litter technique in psychological research. *Psychol. Bull.*, 1957, **54**, 145-151.

Department of Psychology
Vanderbilt University
Nashville, Tennessee

The Journal of Genetic Psychology, 1963, **102**, 277-285.

CONCEPTS RELATED TO NORMAL READING PROCESSES AND THEIR APPLICATION TO READING PATHOLOGY*

Pediatric Language Disorder Clinic, Columbia Presbyterian Medical Center

KATRINA DE HIRSCH, F.C.S.T.[1]

A. THE READING PROBLEM

The literature on the physiology and psychology of normal reading is vast and, if one combines European and American research, probably goes into thousands of publications.

Historically, studies concerned with reading pathology were, until the last generation, mainly confined to work done by neurologists like Wernicke (32), Pick (27), Goldstein (11, 12), and Conrad (5, 6) who discussed the often gross reading disturbances arising from cerebral trauma. Of these neurologists, Orton (24, 25), Schilder (29), and Bender (3) were the ones who were primarily concerned with the developmental reading disabilities found in children. However, the growing number of individuals involved in the research of children's reading difficulties have only recently begun to relate findings to what is known about normal reading processes.

What is reading? Reading is the successful response to the visual forms of language. The understanding of graphically fixed language units is the goal of reading.

A large number of structures and functions are involved in the process. To begin with, there is the peripheral mechanism. The decisive organ for visual perception is, of course, the eye. But reading is obviously more than and different from seeing. The visibility of letters is not the same as their readability. Our dyslexic children do see letters, but they do not grasp their symbolic significance. Reading is not only concerned with visual perception. it is in the last instance an intellectual act.

There are, of course, some reading difficulties which are related to gross visual problems (28). Cleland (4) feels that far-sightedness and lack of binocular vision contribute significantly to reading difficulties. However, visual disturbances are probably far less frequently a factor in reading disabilities than is often assumed. A report of the ophthalmological section of the

* Received in the Editoral Office on July 5, 1961.

[1] Director Pediatric Language Disorder Clinic, Columbia Presbyterian Medical Center, New York City. Lecturer in Pediatrics, Columbia University.

Los Angeles County Medical Association published in 1940 (23) still seems pertinent:

> Only if visual acuity is reduced 50 per cent or more will the child have trouble with interpretation of symbols he can not see well. Except in far-sightedness of a marked degree, the child's power of focusing is sufficient to give adequate though not perfect vision. A small amount of myopia might be an advantage rather than a disadvantage. Crossed eye with normal vision in one eye has little or no effect on reading ability.

In reading the eye has a double task, a visual and motor one. The latter is served by a complex system of muscles and nerves. The eye does not rest on the text but glides along the printed line not in a continuum but in a succession of movements and fixations.

The discussion whether or not fusion difficulties and/or faulty eye movements are responsible for reading difficulties is still going on. Orton (26) and Tinker (30) deny the significance of faulty eye movements in the etiology of reading disorders. Research has shown that the differences in number of eye fixations in excellent and in poor readers is surprisingly small. The Los Angeles report quoted above says:

> So-called faulty eye movements as judged by regressions depend primarily on poor understanding of subject matter, not on uncoordinated eye muscles, not the eye but the brain learns to read.

Kainz (16) in Vienna also maintains that the number of eye movements is a function of the ability to grasp meaning and not the other way around.

This is not the place to discuss cortical functions involved in reading. Suffice it to say that during the last generation the concept of what happens in the reading process has undergone considerable modification. Neurologists no longer believe that precisely pinpointed brain areas are responsible for specific performance. True, we do know that in lesions of the angular gyrus the interpretation of graphic signs is impaired or lost. We also know that the areas adjacent to it do stimulate processes involved in reading which is a learned activity and needs a degree of maturation for functioning. However, we no longer believe that in reading we deal with separate and summative cortical excitations, rather, we assume the existence of highly complex activities involving the whole brain.

The angular gyrus clearly is not the only area significant in reading. We know, for instance, that in sensory aphasia characterized by inability to understand the spoken word, reading is often impaired as well. It appears thus that for reading comprehension auditory language centers are extremely important.

This leads to a question which has concerned research workers for some time. Does the printed word or letter act as a trigger which releases meaning directly? Is there a straight road leading from the visual graphic representation of the word to the concept? Or does the printed word trigger its oral counterpart, the spoken word, which in turn releases meaning? Does the printed word "mat," a series of letters seen, a sequence in space, evoke directly the concept of mat? Or is the printed word consciously or unconsciously translated either overtly or in inner speech into a series of sounds heard, a sequence in time which in turn evokes the concept of "mat"? Kainz (16) feels that the highly skilled reader proceeds directly from the printed symbol to the underlying concept, that he needs a minimum of inner sound. He believes that the familiar printed word is in itself a carrier of meaning, an assumption which has probably influenced the teaching of reading everywhere.

The opposite position is taken by people like Orton (25) who say that the various levels of language function are so closely interrelated that they cannot be considered separately, that speech and reading represent a continuum in language development, that the visual and the auditory structure of the word are intimately bound up with each other. Schilder (29) conceived of alexia as a disturbance involving the sound structure of the written word. Head (14) felt that in reading the conventional graphic sign has to be translated silently or aloud into auditory verbal form. Unskilled readers find it necessary to form with their lips the spoken equivalent of the printed word, they have to *say* the word in order to grasp its meaning. There are many other workers in the field who maintain that even fluent readers evoke the auditory and motor images symbolized by printed letters but that these images are so fleeting and of so short a duration, the process goes so fast, that the individual is not necessarily aware of it. Even the practised reader will resort to vocalization when he meets an unknown word or tries to understand a difficult passage. It is likely that inner speech phenomena evoked by reading are never completely eliminated. How many vocal cues are needed is probably a matter of reading proficiency.

However, evoking the auditory image of the word during reading is only part of the process. If one analyzes the reading process, one finds a number of partial performances; there is the perceptual grasping of letters and word configurations, there is their evocation in inner speech, there is the comprehension of syntactical relationships, the construction of anticipatory schemata as to what the sentence is going to say, there is finally the assimilation of content into the already existing framework. All of this constitutes

an integrated performance, one part influencing the other. It is only in unsuccessful reading experiences—as when someone reads a text aloud but does not grasp its significance—that one can separate out the partial performances (16).

B. Whole-Part Learning

One of the basic problems in reading research is the question whether the skilled reader integrates letters or sounds into wholes, or whether the printed word is experienced globally. An answer to this question is obviously pertinent in terms of the battle now raging between the groups which teach reading in a global fashion and those who believe that words should be broken up into their phonetic elements and then blended into units. The theoretical philosophical foundation for the global approach is based on Gestalt psychology, and it is imperative to discuss how this theory influenced the different systems of teaching reading.

Gestalt psychology as originally conceived by Wertheimer (33, 34) defines Gestalt as that function of the organism which responds to a given constellation of stimuli as to a whole. There is an innate tendency in human beings to experience whole configurations. We respond to a series of musical tones as to a tune—a melody—even if it is transposed into another key. The single elements—the separate notes—may be different, but the physiognomy of the configuration—the relationship of the parts to the whole—remains constant, the figure stays the same. We respond to a series of pencil strokes as to a square even if the square is presented at a different angle. As defined by Gestalt psychology, visual forms obey certain laws: (*a*) Form is characterized by being separated and standing out from the ground. (*b*) The whole and its parts mutually determine each other's characteristics. (*c*) The various parts of a form have different values, some are indispensable if wholeness is to be retained, others are relatively unnecessary. (*d*) There is a tendency of the organism to complete unfinished Gestalten. These are only a few of these laws.

While the original Gestalt experiments have been done with simple visual forms like circles and squares and while letters are, of course, much more complex, much of what is true for simple forms is true also for letters and words. We do not see all the single elements in a word, we see their characteristic features; words have a physiognomy, a particular relationship between the whole and the parts which makes it possible to recognize them, no matter if they are printed large or small, black or red, whether the print is good or relatively poor. We know that if one tears a word apart and prints

it in separate syllables it takes 66 per cent longer to read it because as a result of the separation the Gestalt quality gets lost. In one of his experiments Korte (20) presented words from a long distance so that they were at first quite indistinct and diffuse. The first impression of the word was a global one, including Gestalt qualities like roundness, length, squareness, and so forth. The second phase of recognition began with the moment when a characteristic single detail was recognized as decisively influencing the total Gestalt.

In order to prove their point, which is that good readers are global readers, some Gestalt adherents point to the fact that proficient readers make poor proofreaders since they are apt to overlook misprinted letters. It is quite true that such readers receive at best a slight shock on meeting the misprinted word because its physiognomy has somehow changed, it looks slightly unfamiliar. The skilled reader has to force himself to go back and check on each single letter. Since good readers are global readers, many educators and psychologists have concluded as a result that global reading is the correct method to teach children. However, as Daniels and Diack (7) point out, the process of learning to read is precisely a matter of turning an undifferentiated whole into a differentiated one. It is only the skilled and not the beginning reader who sees words in a structured and organized way. The child often does not. His ability to differentiate is as yet undeveloped.

Moreover, it would be unwise to underrate the importance of the determining letters as constituting elements of the whole configuration. It is not true that word configurations are necessarily and always experienced as ready and finished wholes. Many Gestalt adherents admit that letters, too, are Gestalten, partial Gestalten, it is true, but possessing nevertheless the same quality as do whole words. We do not see all the single elements in a letter; what we do see is a characteristic configuration, which makes it possible for us to recognize a letter as such and enables us to discriminate, for instance, a T from an F, regardless of whether this T is large or small, printed in black or red, written in one handwriting or in another. Like the word, the letter has a Gestalt also in the sense that it is structured, separate, that it stands out.

What it amounts to is this: in normal reading analysis of wholes and integration of parts goes forward simultaneously and the combination of both makes for good reading.

One can describe these processes in different terms: it has been stated that both apperceptive and assimilative activities take place during reading. Under apperceptive reading one understands the ordering of perceived letters and letter groups into word configurations. Assimilative reading, on the other

hand, is geared to large meaning units. In assimilative reading visual perception only acts as a stimulus. Reading processes go forward not only during eye fixations but also during eye movements. When one has to read a large number of books professionally—perhaps for a publisher—one only grasps the important words. All depends on the material and the goal. A research paper is read differently from a light novel. But even assimilative reading depends on smooth perceptive and apperceptive functioning (16).

To pull it together: Both word and letter configurations are probably grasped on the basis of their determining features. Certain readers may tend to the apperception of larger Gestalten but even if they grasp them more or less as a whole they still must be able to quickly and reliably analyze them into their elements. Reading in other words requires both integrative and differentiating functions.

Normal children need only a few exposures of a particular printed word to recall it consistently. Langman (21) describes it when she says that these youngsters easily perceive visual spatial Gestalten—patterns which have a complex and distinct internal design as well as a general outline and configuration.

C. Whole-Part Disabilities

Children with severe reading disability have trouble with the very same functions which were found to be essential in normal reading; namely with integration and differentiation of visual patterns, or, to put it differently: with organization and structuralization of visual spatial Gestalten.

Hughlings Jackson (15) calls alexia—the loss of reading ability resulting from brain injury—a functional regression of a highly organized activity to earlier stages of development. Leischner (22) and Conrad (5, 6) conceive of it as a result of a process of de-differentiation. If this be so—if we think of alexia as a disruption or a breakdown of formerly well established schemata—we could postulate that the dyslexic child would find it difficult to learn to structure these schematas in the first place. It appears that these children's ability to respond and organize visual Gestalten is either inherently weak or lagging. Studies on normal development show a steady progression in differentiation and integration from early childhood through adolescence. The normal child will not be able to cope with as complex a skill as is reading before he has reached a degree of maturation. Most youngsters are ready around the age of six and a half—and the large majority of them learn to master the process regardless of the method of teaching. There is no

doubt as to the fact that the spelling method of learning to read used so successfully in teaching children for generations was a poor one. Cee Ai Tee never did make "cat" but most youngsters learned to read in spite of it. Why? Because they learned to integrate short units into longer ones and to analyze wholes into their determining parts simply because they were exposed to them.

Dyslexic children find these processes extremely difficult. We believe that their neuro-physiological immaturity makes it hard or impossible for them to perceive and respond to complex Gestalten. As a result of many years of clinical investigation we feel, moreover, that these youngsters reveal dysfunctions and immaturities not only in reading but in other areas as well (8).

Orton (24) has shown how many dyslexic children are dyspraxic. Movement, like perception, requires patterning. A skilled motor act is not a succession of single isolated movements. A summation of separate movement units will not result in a fluid rhythmic performance. A motor act is a total Gestalt and since dyslexic children's Gestalt competence is often weak, it is not surprising that many of them are very clumsy.

The same children mostly have difficulty with spatial organization—to wit, their confusion in motor leads, their trouble with spatial sequences, their tendency to reversals, their difficulty with left to right progression, which have been described frequently (13).

Bender (2) has clearly shown the striking immaturitry of Gestalt functioning in dyslexic children in terms of visuo-motor organization.

A large number of researchers—among them Orton (25), Weiss (31), de Hirsch (10) and Arnold (1)—have discussed these youngsters' poor motor speech patterns which reveal their difficulty with the organization of configuration in a temporal sequence. These children's tendency to reverse sounds in words and words in sentences, their telescoping of long words, their omissions and substitutions, all bear witness to their trouble with differentiation and integration of complex auditory-motor patterns. The very monotony and dysrhythmia of dyslexic children's speech is symptomatic for their trouble with structuralization of temporal Gestalten.

Gestalt psychology says that any coherent form is characterized by standing out in relief. Dyslexic children often lack the ability to differentiate figure from ground. Nothing on the page stands out for them; the printed symbols to them look like an undifferentiated, meaningless design (9).

To summarize: Dyslexic children have trouble with various types of Gestalten. Their patterning of motor, visuo-motor, and perceptual configura-

tions is often primitive. What then happens to them if they are confronted with the very abstract, very complex patterns represented by printed words and phrases?

Some dyslexic children have the greatest difficulty remembering even the shape of single letters. Not words only, but letters also are highly unstable. They look dangerously alike. They have no separateness, they lack a clear-cut physiognomy. These children cannot abstract the unessential features in a letter and pick out the determining ones, those which make, for instance, a letter look like an "F." After much drill they may learn to identify the letter, but only when it is presented in isolation: not when it is embedded in a word, or when it is printed in another color, or when the size is enlarged or reduced. These children are unable to maintain the identity of the Gestalt; they cannot transfer the characteristic Gestalt quality into another configuration. Most unstable for them are, of course, those letters which actually *look* alike, as do b and d, and p and b and whose only differentiating feature is one of spatial arrangement.

If for dyslexic children short configurations like single letters are unstable, how much more must be longer ones—words.

Phonetic teaching does not only reduce the length and the complexity of Gestalten; it is helpful also because it relates the visual to the auditory structure of the word and thus facilitates inner speech phenomena (29). In the teaching of phonetics single letters and sounds—partial visual and auditory wholes—are learned separately and are slowly fused into larger entities. However, no matter how children learn to read—in larger or smaller units—reading is never (even if taught phonetically) a process of adding one sound or one letter to another.

One of the Gestalt laws says that the whole is more than and different from the sum of its elements. It has been shown in brain lesions, for instance, that a patient was able to read the two halves of the word "figure" and "head" but not the word "figurehead." Some of our dyslexic children have immense difficulties learning to fuse single sounds into longer units. Not unlike aphasiacs, they find it difficult to integrate parts into wholes. However, the majority does catch on when taught shorter units and there comes a moment during the remedial process when the Gestalt function seems to "jell," when the child no longer has to laboriously add and blend unit for unit, a moment when the process changes qualitatively and the youngster begins to integrate and differentiate spontaneously.

Thus in the final analysis there is no dichotomy between part and whole learning, since both are inherent in the reading process—it is rather a

matter of which size configuration the child is ready for. Whole words and whole sentences are obviously more meaningful than sounds are. However, the point about dyslexic children is that their Gestalt competence is weak to begin with; thus they do need additional help with the structuring and organization of wholes and often do better with shorter configurations.

There is another problem which can best be elucidated with the help of Gestalt psychology. Why, for instance, do many dyslexic children sometimes recognize long and complicated words and have such trouble with short and seemingly easier ones? Why can they read a word like "courageously" and are confused between "there," "then," "when" and "where"? For two reasons: the abstract nature of the small grammatical words which represent spatial, temporal, and causal relationships makes them difficult to remember. Moreover, they are of about equal length, they lack physiognomy, the characteristic features which make for recognition.

D. Summary

To sum up: I have tried to highlight briefly some aspects of normal reading processes which seemed pertinent in terms of children suffering from severe reading disturbances. It appears that skilled reading requires a high degree of integration and differentiation, an ability which is defined by Gestalt psychology as competence in perceiving and responding to complex and highly organized configurations.

The very features which make for skilled reading—namely, integration and differentiation—are either deficient or lagging in dyslexic children. In fact, our clinical investigation seems to prove that these youngsters have trouble with organization not only of complex linguistic forms but also with more basic motor, visuo-motor, and perceptual schemata.

Any remedial approach has to take into account the fact that dyslexic children have basic configurational difficulties. While the aim in reading undoubtedly is the assimilation of large meaning units, any method that facilitates the organization of small or large Gestalten and which links the visual to the auditory image of the word will be helpful.

References

1. Arnold, A. Studies in tachyphemia. *Logos*, 1960, **3**, 25-45.
2. Bender, L. A visual motor Gestalt test and its clinical application. Amer. Orthopsychiat. Assn., Res. Monog. No. 3, 1938.
3. ———. Problems of Conceptualization and Communication in Children with Developmental Alexia: Psychopathology of Communication. New York: Grune & Stratton, 1958.

4. Cleland, D. Seeing and reading. *Optometry*, 1953, **30**, 467-481.
5. Conrad, K. Beiträge zum Problem der Parietalen Alexie. *Arch. Psychiat. Nervenkr.*, 1948, **181**, 398-420.
6. ———. Aphasie, Agnosie, Apraxie. *Fortschr. Neurol. Psychiat.*, 1951, **19**, 291-325.
7. Daniels, J. C., & Diack, H. The phonic word method. *Reading Teacher*, 1959, **13**, 14-21.
8. De Hirsch, K. Specific dyslexia or strephosymbolia. *Folia Phoniat.*, 1952, **4**, 231-248.
9. ———. Gestalt psychology as applied to language disturbances. *J. Nerv. & Ment. Dis.*, 1954, **120**, 257-261.
10. ———. Diagnosis of developmental language disorders. *Logos*, 1961, **4**, 3-9.
11. Goldstein, K. The Organism. New York: American Book, 1929.
12. ———. Language and Language Disturbances. New York: Grune & Stratton, 1948.
13. Harris, A. J. Lateral dominance, directional confusion and reading disability. *J. of Psychol.*, 1957, **44**, 283-294.
14. Head, H. Aphasia and Kindred Disorders of Speech (Vol. I). New York: Macmillan, 1926.
15. Jackson, J. H. Selected Writings of Hughlings Jackson (J. Taylor, Ed.) New York: Basic Books, 1958.
16. Kainz, F. Psychologie der Sprache (Vierter Band, Spezielle Sprachpsychologie). Stuttgart: Ferdinand Enke Verlag, 1956.
17. Katz, D. Gestalt Psychology. London: Methuen, 1951.
18. Koffka, K. Principles of Gestalt Psychology. New York: Harcourt, Brace, 1953.
19. Köhler, W. Psychologische Probleme. Berlin: Julius Springer, 1933.
20. Korte, W. Über die Gestaltauffassung im indirekten Sehen. *Z. Psychol.*, 1923, **93**, 17-82.
21. Langman, M. P. The reading process: A descriptive, interdisciplinary approach. *Genet. Psychol. Monog.*, 1960, **62**, 3-40.
22. Leischner, A. Über den Verfall der menschlichen Sprache. *Arch. Psychiat. Nervenkr.*, 1951, **187**, 250-267.
23. Los Angeles County Medical Association. Report of the Ophthalmological Section of the Los Angeles County Medical Association, 1940.
24. Orton, S. T. Some Studies in the Language Function. *Proc. Assoc. Res. Nerv. & Ment. Dis.*, 1932, **13**, 614-633.
25. ———. Reading, Writing and Speech Problems in Children. New York: Norton, 1937.
26. ———. Visual function in strephosymbolia. *Arch. Ophthal.*, 1943, **30**, 707-717.
27. Pick, A. Aphasie, Handbuch der Normalen u. Pathologischen Physiologie, 1913, **15**, 2. Hälfte, 1416-1524.
28. Robinson, H. M. The findings of research on visual difficulties and reading. In *Reading for Efficient Living*. New York: Internat. Reading Assoc. Conference Proceedings, 1958, **3**, 107-111.
29. Schilder, P. Congenital alexia and its relation to optic perception. *J. Genet. Psychol.*, 1944, **65**, 67-88.
30. Tinker, M. A. Eye movements in reading. *J. Educ. Res.*, 1936, **30**, 241-277.
31. Weiss, D. Basic Considerations on Cluttering. New York: Society for Speech and Voice Therapy, 1950.
32. Wernicke, D. Der aphasische Symptomen Komplex. *Deutsche Klinik*, 1901-3, **6**, 487-556.

33. Wertheimer, M. Gestalt theory. *Soc. Res.*, 1944, **11** No. 1, 78-99.
34. ———. Untersuchungen zur Lehre von der Gestalt. *Psych. Forsch.*, 1922, **1**, 47-58.

46 East 82nd Street
New York 28, New York

The Journal of Genetic Psychology, 1963, **102**, 289-294.

STUDIES IN OPERANT CONDITIONING: IV. EXTINCTION OF ONE-TRIAL LEARNING COMPARED WITH FREE EXPLORATION* [1]

Department of Psychology, University of Denver

ALFRED B. SHAKLEE

A. INTRODUCTION

Considerable interest attaches to single-trial learning, for here, in one sense, we have habit in its smallest units. It is scarcely debatable that organisms other than the simplest invertebrates are capable of such learning. If an organism has any ability to learn at all, this implies that the individual trials must produce a change, at least internally, if not in overt behavior. However, below the primate level, problems of measurement have contributed to a scarcity of clear demonstrations of this phenomenon. It is to be expected that different mechanisms may be involved in various instances of one-trial learning, and that learning (which is often defined in terms of practice) may at times be difficult to distinguish from other processes, when behavior is altered by a single experience.

One-trial position habit reversal in the rat was demonstrated by Buytendijk (1) in 1930, and more recently by Dufort, Guttman, and Kimble (2). Skinner (14) presented in 1933 a cumulative response curve following the triple reinforcement of a single lever response in the rat, showing a typical extinction trend over 40 minutes, and later (16) offered evidence for very rapid instrumental conditioning in the pigeon. In a study of the retention of apparent fear in rats after a single experience with electric shock, Hudson (6) cited impressive qualitative observations indicating considerable retention after one month, although control data were lacking. Jarvik and Essman (7) have provided evidence for 24-hour retention of the effects of a single electric shock in the mouse, and Maatsch (8) has plotted the course of extinction immediately after one shock experience in the rat.

Our understanding of rapid learning has been considerably clarified by the above research, but evidence is needed on the course of delayed extinction after one-trial learning. There is also a need to compare such extinction with

* Received in the Editorial Office on July 12, 1961.

1 This research was supported by a Faculty Research Grant and by funds from the College of Arts and Sciences, University of Denver.

the course of operant responding in comparable untrained animals. In previously reported studies (12, 13) it was found that a panel-pressing response in rats could be established rapidly, and if desired, without experimental adaptation. This response has been employed for comparing, after a lapse of 24 hours, the behavior of nonreinforced animals, with that of animals having had a single reinforced trial.

B. Method

The general procedure has been described earlier (12). Briefly, female hooded rats not previously used in experimentation were given adaptation experience on five different days. Subsequently, at the age of 112-116 days, and when 20-22 hours hungry, they were placed in the test apparatus. Experimental *S*s were allowed to press a panel to obtain a single small piece of food. Control *S*s were placed in the apparatus without access to the panel, which in these instances, was covered by a sliding door. Each group contained five *S*s which had been previously assigned at random.

A record was kept of the time required by each experimental *S* to secure the goal food, in order that the corresponding control *S* could be left in the apparatus for the same amount of time. Experimental and control *S*s were run in alternation. After the initial trial, animals were returned to individual home cages and given 8 g. of Purina Laboratory Chow, which was in all cases consumed within two hours. Twenty-four hours after the initial run, each *S* was given 12 extinction trials in the apparatus, and a record kept of latency of panel-pressing response. If no response occurred within 60 seconds, this figure was recorded as the latency and the trial was terminated. Intertrial intervals, during which the sliding door was closed, were 60 seconds in duration.

C. Results and Discussion

In order to increase the stability of the recorded performance, median scores by blocks of three trials were obtained for each animal. Graphs of the means and medians of these scores are presented in Figure 1. The trends in response latency indicate that the animals having received a single reinforcement extinguished to the "untrained" operant response level in from nine to 12 trials. The graphs of means reflect some of the variability involved, particularly in the operant level of the exploratory behavior. Graphs of the medians suggest more simply the convergence of the two groups with time. There was no evidence to suggest any systematic change in responding among control animals over the time period studied.

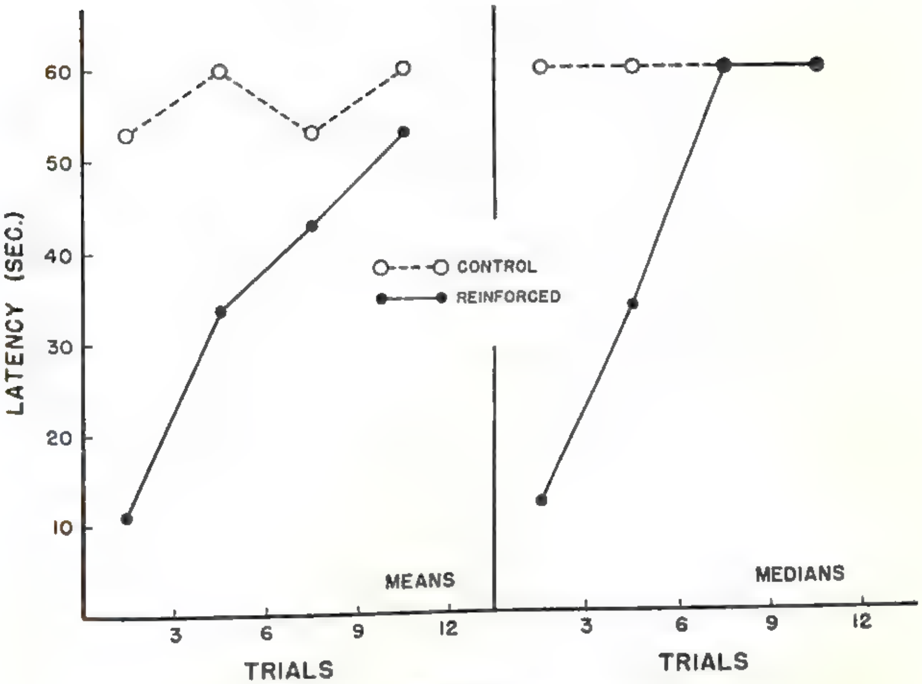

FIGURE 1
EXTINCTION 24 HOURS AFTER A SINGLE REINFORCED TRIAL
(Group means, left; medians, right)

The significance of the difference in extinction trends was assessed by the Wilcoxon test. Median latencies for the blocks of trials one to six and seven to 12 were separately computed for each animal, and difference scores obtained in each case between the first and second halves of extinction. Comparison of experimental and control groups in terms of the Mann and Whitney tabulation of the Wilcoxon test, yielded a two-tailed probability of .008. It should be understood, of course, that inferences relating to effects of reinforcement apply only to the food reward manipulated in the study. Other parameters involving the previous home cage reinforcement history of the animal may well be related to the "exploratory" component of the response.

Guthrie has proposed that learning, in its essential elements, is always established in one trial. He states, ". . . a stimulus pattern gains its full associative strength on the occasion of its first pairing with a response" (4, p. 30). The single practice trial is often not sufficient to modify behavior, in this view, because of the changing stimulus situations in which organisms

operate. Skinner, however, turns directly to the realm of performance and emphasizes the importance of the single reinforcement in actual behavioral modification.

> A single reinforcement may have a considerable effect. Under good conditions the frequency of a response shifts from a prevailing low value to a stable high value in a single abrupt step (16, p. 67).

One of the earliest recognized relationships in the study of evolution has been the parallel between the waning of the importance of instinctual adjustments in higher forms and the development of capacity for more complex learning. Single-trial learning, however, is not incompatible with a considerable degree of instinctive control, as shown by Seidman (11) in the position-discrimination reversal of the turtle (*Pseudemys*). It has been demonstrated by Fields (3) that only a single trial is required to develop a light-avoidance habit in the silver salmon, but that more trials are needed to develop avoidance of the dark—for which this species has a natural preference. The close relationship between one-trial learning and the delayed response has been emphasized by Riesen (10), who cited a study by Baerends as a demonstration that such capacity exists even among invertebrates. Baerends showed that the behavior of the female digger wasp during the day was influenced by the amount of food supply found in the nest on the first visit in the morning.

The organism with the ability to establish rapid behavioral modification should be better prepared to deal with environments where potential food supplies and shelter are scarce and are subject to changing conditions. When one considers that strong selection pressures have probably frequently favored such capacity, it is not too surprising that the pigeon and the rat are so nearly the equals of man in the rapid formation and short-term retention of very simple habits. Since habit loss is so often produced through the agency of new learning, man also shares with the pigeon and the rat some efficient mechanisms for rapid forgetting. Natural environments characterized by frequent change are likely to place an adaptive premium on some kinds of rapid forgetting, but such processes will vary in their utility, depending on the species in question, and on existing conditions. Reasoning, even though rudimentary, may be of great advantage in adjustment to change. Basic reasoning processes found over a wide range of species include responsiveness to identity and to difference (9). These processes can not attain their maximum effectiveness without considerable permanence of retention.

Guthrie (5) and Skinner (15) have both emphasized that an organism

does not emit all the learned responses of which it is capable in a situation having some, but not all, of the stimulus elements present during original learning. This principle describes many existing observations on "imperfect" retention. It also clarifies certain roles of learning in biological adaptation. When an earlier learned response is inappropriate in a new environment, it is to the organism's advantage for this environment not to be capable of completely undoing the past learning. If a new environment which does not produce reinforcement following a learned act is very different from conditions under which learning took place, the organism can rapidly exhaust the habit potential available to this particular situation. Simultaneously, considerable habit potential is preserved for the time when the organism is again in an environment which more closely resembles that of original learning, and which, in the long run, can be presumed more likely to provide need fulfillment.

D. Summary

One-trial learning and 24-hour retention of a panel-pressing response for food were demonstrated in the rat. The extinction curve for experimental animals was shown to differ significantly in slope from the trend of operant behavior of controls. These results extend our knowledge of conditions under which lower mammals are capable of very rapid learning, and present needed control observations on the behavior of unreinforced animals. Some evolutionary implications of the capacity to modify behavior on the basis of brief experience have been examined.

References

1. Buytendijk, F. J. J. Über das Umlernen. *Arch Néerl. Physiol.*, 1930, **15**, 283-310. (*Psychol. Abst.*, 1931, **5**, 4386.)
2. Dufort, R. H., Guttman, N., & Kimble, G. A. One-trial discrimination reversal in the white rat. *J. Comp. & Physiol. Psychol.*, 1954, **47**, 248-249.
3. Fields, P. E. Guiding migrant salmon. *Sci. Mon.*, 1957, **85**, 10-22.
4. Guthrie, E. R. Conditioning: A theory of learning in terms of stimulus, response, and association. In Nat'l. Soc. Stud. Educ., *Forty-first Yearbook.* Chicago: Univ. Chicago Press, 1942. Pp. 17-60.
5. ———. The Psychology of Learning (rev. ed.) New York: Harper, 1952.
6. Hudson, B. B. One-trial learning in rats. *Psychol. Bull.*, 1939, **36**, 643 (Abstract).
7. Jarvik, M. E., & Essman, W. B. A simple one-trial learning situation for mice. *Psychol. Rep.*, 1960, **6**, 290.
8. Maatsch, J. L. Learning and fixation after a single shock trial. *J. Comp. & Physiol. Psychol.*, 1959, **52**, 408-410.
9. Nissen, H. W. Axes of behavioral comparison. In A. Roe, & G. G. Simpson (Eds.), *Behavior and Evolution.* New Haven: Yale Univ. Press, 1958. Pp. 183-205.

10. RIESEN, A. H. Learning. In R. H. Waters, *et al.*, *Principles of Comparative Psychology*. New York: McGraw-Hill, 1960. Pp. 117-207.
11. SEIDMAN, E. Relative ability of the newt and the terrapin to reverse a direction habit. *J. Comp. & Physiol. Psychol.*, 1949, **42**, 320-327.
12. SHAKLEE, A. B. Studies in operant conditioning: I. Acquisition of a panel pressing response. *J. Genet. Psychol.*, 1963, **102**, 19-25.
13. ———. Studies in operant conditioning: III. Learning in the rat without prior experimental adaptation. *J. Genet. Psychol.*, 1963, **102**, 33-36.
14. SKINNER, B. F. "Resistance to extinction" in the process of conditioning. *J. Gen. Psychol.*, 1933, **9**, 420-429.
15. ———. Are theories of learning necessary? *Psychol. Rev.*, 1950, **57**, 193-216.
16. ———. Science and Human Behavior. New York: Macmillan, 1953.

Department of Psychology
University of Denver
University Park
Denver 10, Colorado

The Journal of Genetic Psychology, 1963, **102**, 295-310.

COMPARATIVE STUDIES OF TEMPERAMENT: FEAR RESPONSES IN DIFFERENT SPECIES OF FISH*

Department of Psychology, University of Denver

ALFRED B. SHAKLEE

A. INTRODUCTION

Differences in temperament among animal species are important forces in biological adaptation. The study of such differences should help clarify selective factors involved in the evolution of emotional processes, and should indirectly offer insights into the effects of changing environments on human emotional behavior.

The term *temperament* is used to refer to such interrelated dimensions as fearlessness-timidity, dominance-submission, agressiveness, and playfulness. More specifically, the concept is employed to represent relatively stable patterns of response which are associated with emotional behavior or with certain types of autonomic nervous system function at central and peripheral levels. Such a definition allows of both genetic and environmental influences in the development of temperament.

Although temperament is often expressed in complex ways, it can at times be reflected in simple behavioral dimensions such as, muscle tension-relaxation, movement-immobility, approach-withdrawal, seeking-avoidance, and avoidance-nonavoidance. The value of such dimensions for clarifying basic aspects of behavior is well demonstrated by Schneirla (34) in his use of approach and withdrawal for analyzing evolutionary aspects of motivation.

Excellent summaries have been provided by Munn (29), Hall (17), and Fuller and Thompson (14) of research demonstrating genetic influences on temperament, and by Beach and Jaynes (3) of evidence on the influence of experience. Clear differences in such factors as timidity and savageness have in several cases been demonstrated between strains of animals within a species. However, at the level of interspecies comparison, while there exist valuable qualitative descriptions, there is little information on temperamental differences of a quantitative nature.

King and his co-workers have recorded behaviors which are presumably related to differences in temperament in two subspecies of the deermouse, *Peromyscus maniculatus*. The docile subspecies *gracilis* was compared with

* Received in the Editorial Office on July 12, 1961.

bairdii, a wild and timid subspecies. The groups differed in behavior on an elevated maze (23) and in response to early handling (22). Differences in mating behavior, possibly related to differences in temperament, and constituting demonstrations of psychosexual isolation in the laboratory, have been shown for two fish species, *Xiphophorus maculatus* and *X. helleri*, by Clark, Aronson and Gordon (9).

Observations related to temperament in fish have seldom been made in their own right, but have usually come from research concerned with response patterns like those of territoriality, mating, and parental care. Valuable summaries of such work have been provided by Aronson (1), Baerends (2), Thorpe (41), and Tinbergen (42). Of special interest are the observations of Breder and Halpern (6) that fear could induce schooling behavior in *Brachydanio rerio*, and the findings of von Holst and Schoen that orientation to gravity and to horizontal illumination was influenced by the state of rest or excitement of the animal—cited by E. G. Healey (18).

The experiments which follow were designed to compare measures of temperament in different species of fish. Several sets of pilot observations on different species were performed prior to adopting the methodologies described.

B. Methods

1. *Light Avoidance*

The fish were tested in a tank of clear acrylic plastic 9-1/2 × 21 inches, resting on sponge rubber on a laboratory table, and containing conditioned water to a depth of four inches. The two ends and back of the tank were covered with white paper on the outside. Paper underneath the tank was gray for the left hand three-fourths of the area, and white for the right one-fourth, a distance of 5-1/4 inches. Above, the tank was covered by black painted masonite except for a distance of four inches at the extreme right where there extended from front to back a rectangular lamp housing for a 13-1/2-inch fluorescent bulb of 14 watts. The bulb, the only source of illumination in the room, was 9-1/2 inches above the water level, with its housing so tilted that the brightest illumination was concentrated on the white area below.

It was desired to make observations which would reflect *S*'s avoidance of the brightly illuminated right-hand area after varying periods of elapsed time. Accordingly, the score for each observation period was the time spent in the center 50 per cent of the tank plus twice the time spent in the right one-fourth of the space. As a guide for positioning the observer's eye to

determine when *S* moved from one area to another there was set before the tank a frame having two pairs of vertically fastened strings. The strings in a pair were separated by 1-3/4 inches in a plane perpendicular to the tank, with the string nearest the tank removed from it by a distance of three inches. These sighting strings formed boundaries between the right and left extreme fourths of tank space and the center 50 per cent. A 15 × 24 inch one-way vision screen of metallized cellulose acetate (35) was placed between sighting strings and the observer.

Fish, used in these experiments, were kept in the animal room for at least 48 hours prior to test, and housed with others of their own species—all species having identical home aquaria. During the experiments, the animal room temperatures were between 74° and 77° F., and test tank temperatures were kept between 73° and 75° F. Animals were fed every evening, but never prior to a test to be conducted that day.

A test session began with netting a fish in its home aquarium, placing it in a 400 ml. beaker 2/3 full of water, and taking it to the experimental room. Fish and water were poured into the center of the test tank, toward the darker end. These operations took approximately 30 seconds. After *S* had been in the test tank for 30 seconds, recording was begun for trial one, and total times spent in the center and right hand compartments were recorded separately. The reference point on the fish for recording his location was an imaginary point midway between the eyes. Time scores were recorded for six trials, the first four being each two minutes in length, and the last two each having a duration of four minutes. Between each pair of trials there was an interval of one minute, so that the last trial ended 21 minutes after the start of trial one.

Fish used in this experiment were seven *Cichlasoma meeki* (the firemouth), six *Xiphophorus variatus* (Platy variatus—two males and four females), and five *Brachydanio rerio* (zebra fish). Thus, the species sampled included representatives of the Cichlidae, the Cyprinidae, and the Poeciliidae. The fish were all relatively young, with approximately the following lengths and body weights:

Species	Length (mm.)	Weight (g.)
C. meeki	32	0.5
X. variatus (female)	28	0.35
B. rerio	27	0.18

None of the *S*s had been previously used in experimental work. Individual *S*s were run in an order which allowed maximal alternation among species.

2. *General Activity*

The second technique was quite similar to open field measures used with rodents. A test tank of clear acrylic plastic, 10 × 17 inches, was filled with water to a depth of four inches. This tank rested on a piece of plywood over a sheet of sponge rubber on the floor. Directly under the tank was a sheet of gray paper marked with two black lines crossing in the center at right angles. When the tank was viewed from directly above center, the lines divided the bottom area into four equal rectangles. Illumination was provided by two 60-watt bulbs, one diagonally above each of the narrow ends of the tank, which were oriented to the left and right of observation point. Each bulb was approximately 10 inches outside and 15 inches above the adjacent water line. A 3 × 7 inch one-way window was placed horizontally 21 inches above the water level, and a black curtain was hung so as to surround the observation window and the tank beneath. A viewing point which allowed one eye to be directly above the center of the tank made possible accurate recording of crossings by *S* from one rectangle to another regardless of *S*'s depth.

All general conditions were the same as in the light-avoidance experiment. The number of times *S*'s whole body moved from one tank area to another was recorded for the first 55 seconds of each minute, for 16 minutes. The *S*s were 6 *C. meeki,* 6 *B rerio,* and 10 *Carassius auratus* (the common goldfish)—the latter about 40 mm. in length and 1.2 g. in weight.

Tests of a different fear stimulus were conducted with six male and six female *Xiphophorus maculatus* (about 30 mm. in length and 0.6 g. in weight) in a circular, tan polyethylene tank, 12 inches in diameter, placed on a table and observed in a mirror. A white cylinder, 4 inches in diameter, blocked off the center of the tank, and a glass cover with four intersecting lines divided the water area below into eight equal sectors. Line-crossings were counted for five three-minute periods after *S* was placed in the apparatus. After this, a 300-gram weight suspended on a 52-inch string was allowed to swing 15 inches and strike the edge of the table. Ten seconds later, three more recording periods were begun. These were followed by a second vibratory stimulus and the same recording sequence.

C. Results

In the light-avoidance test, two species, *C. meeki* and *X. variatus*, showed systematic response patterns, and these have been plotted in Figure 1. In

constructing the graph, each *S*'s scores for the first four two-minute observation periods were combined into two scores representing observation periods of four minutes each. The resulting values and those initially recorded for the two terminal four-minute observation periods yielded performance trends based on four points. Group performance was plotted from median values.

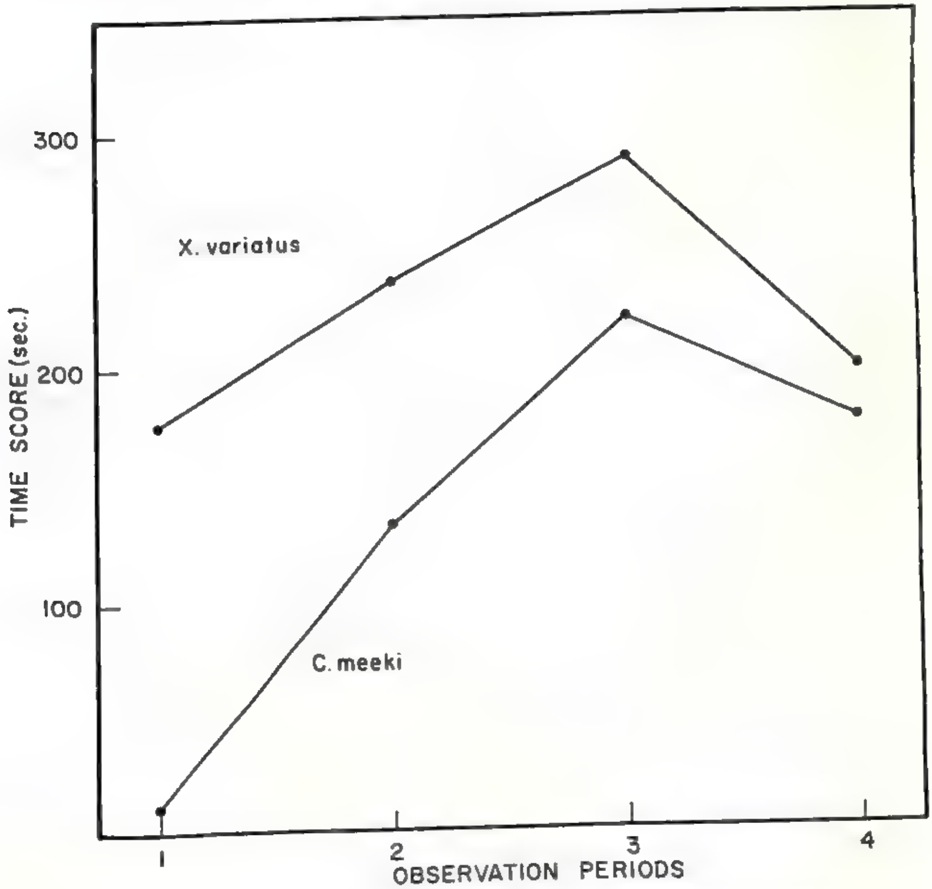

FIGURE 1
CHANGES IN LIGHT AVOIDANCE DURING SUCCESSIVE 4-MINUTE OBSERVATION PERIODS

The aspect of the present measures which seems to have the most relevance to temperament is the variation among species in slopes of response curves. Simple differences in gross activity, while interesting in their own right, may be more a function of normal effector processes, independent of emotion.

Differences in slopes of recovery curves for the three species in the light-

avoidance study were tested for significance by applying the Kruskal-Wallis *H* test to differences between first period score and median score for the three remaining periods. This single-factor analysis of variance yielded a value of 8.4, significant at the .02 level. Slope differences for the two species in Figure 1 were significant at the .05 level by the Wilcoxon test. Both of these species showed a fairly uniform increase in the time spent in brighter light from the first through the third observation periods. The results for *C. meeki* but not for the other species, when assessed by the Friedman test, indicated a significant performance shift ($p < .01$).

Turning to measures of light-avoidance *per se*, *C. meeki* during its first observation period showed significantly more avoidance than either *B. rerio* or *X. variatus*. Wilcoxon tests for independent samples indicated that each of these differences were significant at the .01 level. Later observation periods did not reliably differentiate the groups.

In the measure of line-crossing activity, the 16 counts for each *S* were combined into four successive values, each representing approximately four minutes of observation. The graph of group medians (Figure 2) was limited to *C. auratus* and *C. meeki*, since measures for *B. rerio* were of a much greater order of magnitude. Comparison of the slopes of the recovery curves for the three species yielded an *H* of 9.8, significant at the .01 level. The shift in performance as an individual species trend was significant at the .02 level for *C. meeki*, but was not significant for the other species. The measure of total line-crossing clearly separated each species from the others, as shown in Table 1.

The recovery trends for *X. maculatus* after stimulation showed increasing activity with the passage of time. The trend after netting was shown by the Friedman test to be significant at the .001 level. Following the vibratory stimuli (which also produced visual cues from movement of the water surface), the trend was significant at the .02 level for the first stimulus, and at the .05 level for the second.

D. Discussion

Stimuli acting on the fish prior to test (being netted, placed in a beaker, and introduced into a strange environment) can be expected to have evoked strong physiological responses of fear. Insofar as animals differ in their recovery from such consistent patterns of stimulation, they may be presumed to differ in temperament.

A term like *fear* has somewhat different referents in lower vertebrates

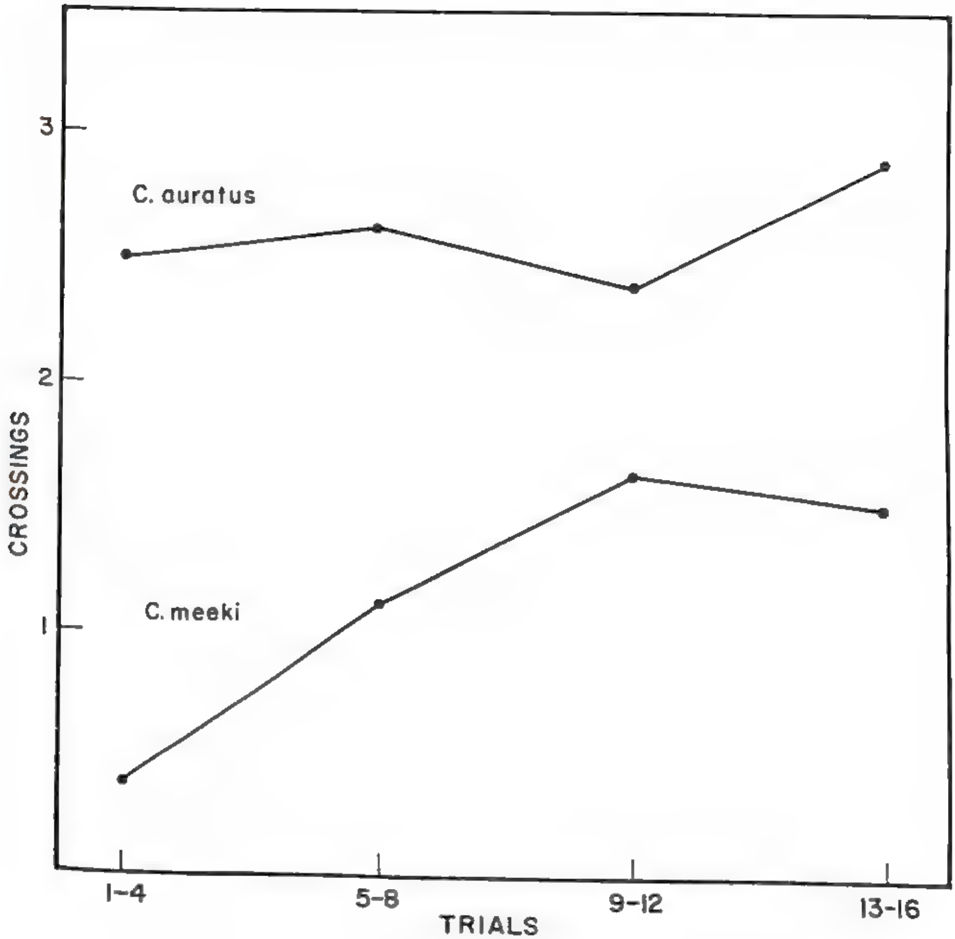

FIGURE 2
Average Frequencies of Line Crossing in the Open Field

than in mammals. Nevertheless, the behaviors and autonomic nervous systems of fish and mammals display a sufficient number of similarities that one may postulate a certain communality of emotional response. Young (48) and Nicol (30) have summarized many features of autonomic innervation in fish. The vagal system is well-developed, though it has been reported that a sacral parasympathetic division is lacking. Vagus stimulation causes contraction of the stomach and inhibition of the heart. Cardiac accelerator nerves, however, have been considered absent in teleosts. There is an extensive chain of sympathetic ganglia, giving off, in the anterior trunk region of some forms, small nerves passing to suprarenal tissue. Exogenous

TABLE 1
SPECIES DIFFERENCES IN OPEN FIELD ACTIVITY

Species	*N*	Line Crossings* Mdn.	Range
C. meeki	6	20.5	14-26
B. rerio	6	144.0	114-180
C. auratus	10	41.5	19-62

* Differences between *B. rerio* and the other two species can be judged by inspection to be significant. *C. meeki* and *C. auratus* are different at the .01 level by the Wilcoxon test.

adrenaline inhibits spontaneous contractions of the stomach and the intestine, and has been found by Wyman and Lutz (47) to produce long-maintained pressor effects along with slowing of the heart in an elasmobranch.

Results obtained for the line-crossing behavior show this to be a reliable measure of recovery from startle, as has been previously shown for locomotion in the open field in the case of rodents. The light-avoidance measure capitalizes on a response of fish noted by a number of previous investigators—cf., Fields (13). This test offers promise of adaptability to phylogenetic studies of emotion and temperament, extending over all classes of vertebrates.

Behavior change was most striking in *C. meeki.* Sudden stimulation in this species, as in other cichlids, produces periods of near immobility. This quiescence may be punctuated by brief, extremely fast darts to a different location. Such darting behavior, when it appeared in the present study early after fear arousal, involved such short movements that it had little effect on the performance measures. In the light-avoidance test, for instance, the occasional early movements of this sort were confined to the darker regions of the test environment. As emotion wore off, the subsequent free locomotion was particularly noticeable in contrast to the earlier immobility.

Trends noted in both the light-avoidance and line-crossing behaviors with the passage of time may have been reflecting the dissipation of neurohumoral components of the fear response. The inhibition of movement in *X. maculatus* following vibratory stimulation, which often evoked only one or two rapid darts, suggests that any contribution of fatigue to the measures is a minor one. The change in movement in *C. meeki* tended to level off at approximately 10-15 minutes. This interval is close to some of the recovery times noted in other experiments on emotion, although different concomitants of emotion are quite variable in their period of decay. Blatz (4) noted in human subjects who had been startled by a backward fall of their chair, that pulse rate returned to normal in about three minutes, while increased force of cardiac contraction was sometimes noticeable eight to 10

minutes later. Some of the correlates of emotion may be brief, as after the application of stimuli of short duration where the galvanic skin response and change in cardiac rate have often been recorded with latencies of one to three seconds and durations of two to twelve seconds. The effect of a major stress, where the status of possible accompanying emotion has not been clearly worked out, was studied by Wiel-Malherbe (45) in human patients following a briefly applied electroshock. Almost immediately after the convulsion there was an increase in plasma adrenaline of about 75 per cent, which subsided to an almost normal level in 10 minutes. Plasma noradrenaline was raised about 40 per cent, and receded more slowly. The present study differed from those just cited in the degree to which it involved continued environmental novelty after the termination of the brief, rapid stimulus change.

Van Iersel (43) studied the effect of fear on the fanning response of the male three-spined stickleback. Fanning is a periodic parental behavior which produces a water current over the nest, thus ventilating the eggs. After being frightened for a few minutes, during which time fanning was prevented, the fish on returning to the nest showed increased fanning for a brief period. One wonders if the peaking and sebsequent downward trend in the present light-avoidance behavior (Figure 1) would with further observations be shown to be a significant effect. It may be that here, as in the situation described by Van Iersel, fear inhibits a behavior while allowing further accumulation of its physico-chemical determinants, so that with the elimination of fear there is a temporary overshooting of what would be the normal output.

The production of near immobility in conjunction with fear, as noted in the present situation, is seen in the natural adaptations of many animals. In young chickens, the development of tonic immobility reactions runs parallel to that of cowering, following apparent fear stimuli in other species of birds (32). To what extent increased adrenaline levels may be implicated in such response, is uncertain, but Hoagland (20) found that exogenous adrenaline prolonged the duration of tonic immobility in *Anolis carolinensis*. Smith and Matthews (38) found that adrenaline derived from mammalian glands depressed oxygen consumption in one species of fish, whereas control injections of sea water (which along with the previous injections must have been emotion provoking) raised oxygen consumption. The observations on heart rate during tonic immobility have not yielded any consistent trend (15). Warden, Jenkins, and Warner have summarized several reports of immobility in fish. The means for inducing this response have included pressing,

stroking, and removing the fish from the water and holding it firmly on its back for a few seconds. The authors comment that, "The shock of being removed from the water is no doubt an important factor in the production of these states" (44, p. 87).

Presumably, adaptation to threat in a natural environment is, for many species of fish, promoted most effectively by immobility only if this response is achieved after flight has taken the individual to protective cover. In this connection, it appears significant that low response levels were not reached immediately in the fish tested. There was frequently a brief flurry of activity after an animal was placed in the test tank and before recording began. A graph which reflected this early behavior could well be expected to show a double inflection in activity change.

Immobility can appear under many circumstances. At one time it may be a mechanism for protection from predators, possibly by production of more effective camouflage. At another time it may be a response to frustration, as during the extinction of a learned response (36). Often it is associated in intraspecies combat with the presentation of a specific "releaser" stimulus pattern by a vanquished animal, in order to prevent further attack by the victor. In the latter category are such responses as the defeated jackdaw's presentation to the victor of the unprotected spot at the base of the skull, or the exposure by the vanquished wolf of a most vulnerable region, the side of the neck (28). Sometimes immobility is elicited by mild stimuli, as in the protective response of deer fawns; at other times it follows only intense stimulation. The "paralysis of fear" occasionally seen in man may share some common properties with immobility reactions having survival value in other organisms.

Species comparisons based on simple response measures must be interpreted with care. Lorenz (27) has cited a number of examples in which near-identical behaviors in different cichlid fish have different and sometimes opposed, significance. Fighting in fish has been found by Kuo (25) to be influenced by spawning season and social experience. In the present research, many different processes could affect the measures taken. Phototropisms and thigmotactic influences are known to vary in importance in the adjustments of different fish species (44). Tendencies of this sort could act as "behavioral traps," keeping certain species in restricted regions of a test environment. Many fish spend a great deal of time in an aquarium pursuing their own reflections. This was noted to some degree in all the species tested, and was especially pronounced in *X. variatus* and *B. rerio*. Such activity could, in different forms, stem from quite different blends of behavioral tendencies,

such as mating, threat, or schooling response. Tinbergen (42) described threat postures made in front of a mirror by the three-spined stickleback; Breder and Coates (5) noted that the male guppy would attempt to mate with the shadow projection of the female; and Shlaifer (37) found that oxygen consumption was decreased in isolated goldfish when they were able to see their images in mirrors, as well as when they were placed in groups. The latter effect is correlated with a social influence on activity, as shown by Escobar, Minihan, and Shaw (12), who measured movement in terms of guide lines which allowed the localizing of a fish at any time in terms of the two centimeter cubes into which the aquarium was divided. There was less locomotion when a fish was a member of a group than when alone. A complicating factor in studies of light-avoidance is found in the fact that some species show different responses to light under different conditions, as in the case of preference for black in normal adult rats and preference for white in rats with lesions of the cerebral cortex (24) and the change in light-responses of salmon with electrical stimulation (13).

Other problems arise from the fact that measures of restricted responses do not begin to reflect the behavioral potential that would be displayed in a natural habitat, and that a laboratory aquarium or testing environment will resemble the natural environments of different species in varying degrees. It must also be remembered that interspecies comparisons are always dependent for their validity on the sampling of individuals for test. In order to rank species with assurance in terms of the present measures, considerably more research will be required.

It is of some interest that *Carassius auratus,* the species which has been domesticated the longest (for perhaps more than 1000 years), showed very little activity change during the observation period and gave a response curve of essentially zero slope (Figure 2). Additional study would be required to indicate to what extent this pattern may be ascribable to effects of domestication. The domestication of many animals has been accompanied by greater docility, and Darwin (11) reported many years ago the decrease in tameness in birds on formerly uninhabited islands as their environment became more threatening. In relation to the present finding, it must be noted that Spoor (39) demonstrated that the goldfish at times reacts with movement to outside stimulation. Measuring deflections of a small paddle by water currents created by the fish, he reported that,

> noise, slight changes in the water level, sudden lights, the mere presence of the observer in the room, or such minor disturbances as the quiet opening and closing of the door to the room usually caused a change in the rate of activity.

In order to reconcile the present findings with those of Spoor it may be necessary both to extend periods of observation and to attempt some clarification of the degree of emotional involvement in different types of activation.

Numerous emotional responses of animals in their natural environments appear clearly to demonstrate the organizational role of emotion emphasized by Leeper (26). In this view, a major function of emotion is the production of more adaptive response to the total situation, at the expense of limited disorganization of ongoing behaviors which subserve ends irrelevant to a present crisis. As Stagner (40) points out it is necessary to distinguish between several levels of homeostasis, which are maintained in differential degrees, depending on the threat of the moment.

When emotional response is generated in an environment very unlike the natural conditions in which the organism's adaptations have emerged, emotion may fail to display adaptive properties, and may even be maladaptive. Observations on captive animals have repeatedly shown that survival can be threatened by "natural" behaviors which are unsuited to the artificial environment. Quantitative observations have suggested that physiological dysfunction associated with change in living conditions of animals may be caused by social factors. Long-term studies of birds and mammals in the Philadelphia Zoological Garden have led Ratcliffe and Cronin (31) to propose that social pressure was partly responsible for increased frequencies of arteriosclerosis through the production of disturbed adrenal function. Christian (7, 8), in studies of artificially crowded populations of rodents, has demonstrated impaired reproduction and other signs of systemic stress, which appeared to stem from sociopsychological pressures.

Environmental change, the stimulus for long-range adaptive modification, is also a recurring source of adaptive impairment, as emphasized by Huxley, Simpson, and others. Darlington (10) has analyzed lag in adaptation as an inevitable source of nonfunctional structure. A species at any given time may thus be considered to have its behavioral adjustment influenced by a quota of such lag. The interpretation of such process is complicated by the possibility that adaptive lag in one environment may, if the population survives the handicap, occasionally become an adaptive advantage in a future environment. Nevertheless, at the human level, thought must be given to the fact that while processes of learning offer the potential for very rapid environmental change of a favorable sort, they also provide the opportunity for more rapid production of adaptive lag.

A large proportion of what we may infer to be adaptive lag in various species appears to relate to dimensions of temperament. Much theorizing

has centered on physical and physiological reasons for the extinction of former species. It seems worth considering to what extent dimensions of emotional reactivity may have contributed to the undoing of some extinct species. For example, too great a quota of "tameness" may have repeatedly been a factor in the disappearance of an animal type.

An increasing body of evidence has demonstrated many ways in which the changing environments of man contribute to nonadjustive response, and Richter (33) has proposed that a considerable proportion of man's adjustive handicaps may be traced to processes inherent in his "domestication." Many of these problems center around aspects of emotional response. It can be argued that over the last few centuries, following man's extremely rapid alteration of living environments, the adaptive lag in dimensions of emotionality has been increasing rapidly.

Various organism-environment discrepancies may be postulated as being responsible for this lag. Attention has been given to the possible negative influences of (*a*) arousal of excessive emotion; (*b*) arousal of emotion without allowing normal outlets, as in repressed fear or anger; and (*c*) arousal of emotion without an object, as in certain anxiety. As a tentative hypothesis, it may be suggested that another source of disharmony between organism and environment may paradoxically at times be found in insufficient activation of the unpleasant emotions of fear or anger. It has been proposed by Guthrie (16) and Hebb (19) that general excitement may be useful to the system as a behavioral support. It has also been suggested that there should be adequate outlets for uncomfortable emotions, once aroused—but few observations bear on the possible need to generate these specific emotions in the first place. An exception is found in the early recognition by Woodworth (46) of the importance of the seeking of fear in many play activities.

It is possible that over and above the need to avoid too bland an environment, the biological systems of various vertebrates, including man, may require for optimal functioning, the occasional generation (with adequate outlet) of emotions which we label "unpleasant," but which have apparently played so large a role in evolutionary survival. Perhaps behaviors suggestive of fear needs develop in human adults mainly under unusual circumstances, such as cited by Janet (21) in two cases of neuroses, where periods of stealing and fear of being caught were accompanied by alleviation of other symptoms. On the other hand, needs to activate fear or anger mechanisms may have some greater degree of generality.

Clarification of the roles of social pressures in man's adjustment will require, not only the study of specific response mechanisms in actual limited

environments, but also increased understanding of the evolutionary significance of emotional reactivity.

E. Summary

Measures based on general activity and on light-avoidance were developed to compare reactions to a fear-provoking situation in different species of fish. It was shown that there were significant differences among species, not only in overall activity level, but also in response change following sudden intense stimulation. Differences between species in terms of the slopes of recovery curves were obtained by both measuring techniques. In those species displaying clear recovery trends, the times required for the return to asymptotic performance were within the range of times noted for recovery from emotion in other vertebrate forms.

Certain aspects of the phylogenetic study of temperament and of emotional adjustment to environment have been discussed. It has been proposed that the clarification of emotional function in man depends upon greatly increased understanding of the evolution of emotional response mechanisms.

References

1. Aronson, L. R. Reproductive and parental behavior. In M. E. Brown (Ed.), *The Physiology of Fishes: Vol. 2. Behavior.* New York: Academic Press, 1957. Pp. 271-304.
2. Baerends, G. P. The ethological analysis of fish behavior. In M. E. Brown (Ed.), *The Physiology of Fishes: Vol. 2. Behavior.* New York: Academic Press, 1957. Pp. 229-269.
3. Beach, F. A., & Jaynes, J. Effects of early experience upon the behavior of animals. *Psychol. Bull.*, 1954, **51**, 239-263.
4. Blatz, W. E. The cardiac, respiratory, and electrical phenomena involved in the emotion of fear. *J. Exper. Psychol.*, 1925, **8**, 109-132.
5. Breder, C. M., & Coates, C. W. Sex recognition in the guppy, *Lebistes reticulatus* Peters. *Zoologica,* 1935, **19**, 187-207.
6. Breder, C. M., & Halpern, F. Innate and acquired behavior affecting the aggregation of fishes. *Physiol. Zool.*, 1946, **19**, 154-190.
7. Christian, J. J. Reserpine suppression of density-dependent adrenal hypertrophy and reproductive hypoendocrinism in populations of male mice. *Amer. J. Physiol.*, 1955, **187**, 353-356.
8. ———. Adverse effects of crowding on lactation and reproduction of mice and two generations of their progeny. *Endocrinology,* 1958, **63**, 517-529.
9. Clark, E., Aronson, L. R., & Gordon, M. Mating behavior patterns in two sympatric species of Xiphophorin fishes: Their inheritance and significance in sexual isolation. *Bull. Amer. Mus. Nat. Hist.*, 1954, **103**, 135-226.
10. Darlington, C. D. The Evolution of Genetic Systems (2nd ed.) New York: Basic Books, 1958.
11. Darwin, C. Journal of Researches (1839). New York: Hafner, 1952 (reprint).
12. Escobar, R. A., Minahan, R. P., & Shaw, R. J. Motility factors in mass

physiology: Locomotor activity of fishes under conditions of isolation, homotypic grouping, and heterotypic grouping. *Physiol. Zool.*, 1936, **9**, 66-78.
13. Fields, P. E. Guiding migrant salmon. *Sci. Mon.*, 1957, **85**, 10-22.
14. Fuller, J. L., & Thompson, W. R. Behavior Genetics. New York: Wiley, 1960.
15. Gilman, T. T., & Marcuse, F. L. Animal hypnosis. *Psychol. Bull.*, 1949, **46**, 151-165.
16. Guthrie, E. R. The Psychology of Human Conflict. New York: Harper, 1938.
17. Hall, C. S. The genetics of behavior. In S. S. Stevens (Ed.), *Handbook of Experimental Psychology.* New York: Wiley, 1951. Pp. 304-329.
18. Healey, E. G. The nervous system. In M. E. Brown (Ed.), *The Physiology of Fishes: Vol. 2. Behavior.* New York: Academic Press, 1957. Pp. 1-119.
19. Hebb, D. O. The Organization of Behavior. New York: Wiley, 1949.
20. Hoagland, H. The mechanism of tonic immobility ("animal hypnosis"). *J. Gen. Psychol.*, 1928, **1**, 426-447.
21. Janet, P. Psychological Healing. New York: Macmillan, 1925.
22. King, J. A., & Eleftheriou, B. E. Effects of early handling upon adult behavior in two subspecies of deermice, *Peromyscus maniculatus. J. Comp. & Physiol. Psychol.*, 1959, **52**, 82-88.
23. King, J. A., & Shea, N. J. Subspecific differences in the response of young deermice on an elevated maze. *J. Hered.*, 1959, **50**, 14-18.
24. Krechevsky, I. Brain mechanisms and brightness discrimination learning. *J. Comp. Psychol.*, 1936, **21**, 405-445.
25. Kuo, Z. Y. Studies on the basic factors in animal fighting: V. Inter-species coexistence in fish. *J. Genet. Psychol.*, 1960, **97**, 181-194.
26. Leeper, R. W. A motivational theory of emotion. *Psychol. Rev.*, 1948, **55**, 5-21.
27. Lorenz, K. Z. The comparative method in studying innate behaviour patterns. In: Society for Experimental Biology, *Physiological Mechanisms of Animal Behaviour.* Cambridge: Cambridge Univ. Press, 1950. Pp. 221-268.
28. Lorenz, K. Z. King Solomon's Ring. New York: Crowell, 1952.
29. Munn, N. L. Handbook of Psychological Research on the Rat. New York: Houghton-Mifflin, 1950.
30. Nicol, J. A. C. Autonomic nervous systems in lower chordates. *Biol. Rev.*, 1952, **27**, 1-49.
31. Ratcliffe, H. L., & Cronin, M. T. I. Changing frequency of arteriosclerosis in mammals and birds at the Philadelphia Zoological Garden. *Circulation*, 1958, **18**, 41-52.
32. Ratner, S. C., & Thompson, R. W. Immobility reactions (fear) of domestic fowl as a function of age and prior experience. *Anim. Behav.*, 1960, **8**, 186-191.
33. Richter, C. P. Rats, man, and the welfare state. *Amer. Psychol.*, 1959, **14**, 18-28.
34. Schneirla, T. C. An evolutionary and developmental theory of biphasic processes underlying approach and withdrawal. In M. R. Jones (Ed.), *Nebraska Symposium on Motivation*, 1959. Lincoln, Nebraska: Univ. Nebraska Press, 1959. Pp. 1-42.
35. Shaklee, A. B. A screen for directional viewing. *Amer. J. Psychol.*, 1958, **71**, 783.
36. ———. Studies in operant conditioning: I. Acquisition of a panel pressing response. *J. Genet. Psychol.*, 1963, **102**, 19-25.
37. Shlaifer, A. An analysis of the effect of numbers upon the oxygen consumption of *Carassius auratus. Physiol. Zool.*, 1939, **12**, 381-392.

38. SMITH, D. C., & MATTHEWS, S. A. The effect of adrenalin on the oxygen consumption of the fish, *Girella nigricans*. *Amer. J. Physiol.*, 1942, **137**, 533-538.

39. SPOOR, W. A. A quantitative study of the relationship between the activity and oxygen consumption of the goldfish, and its application to the measurement of respiratory metabolism in fishes. *Biol. Bull.*, 1946, **91**, 312-325.

40. STAGNER, R. Homeostasis as a unifying concept in personality theory. *Psychol. Rev.*, 1951, **58**, 5-17.

41. THORPE, W. H. Learning and Instinct in Animals. Cambridge: Harvard Univ. Press, 1956.

42. TINBERGEN, N. The Study of Instinct. London: Oxford Univ. Press, 1951.

43. VAN IERSEL, J. J. A. An analysis of the parental behaviour of the male three-spined stickleback (*Gasterosteus aculeatus* L.). *Behaviour, Suppl. 3*, 1953.

44. WARDEN, C. J., JENKINS, T. N., & WARNER, L. H. Comparative Psychology: Vol. 2. Vertebrates. New York: Ronald, 1936.

45. WEIL-MALHERBE, H. The effect of convulsive therapy on plasma adrenaline and noradrenaline. *J. Ment. Sci.*, 1955, **101**, 156-162.

46. WOODWORTH, R. S. Psychology. New York: Holt, 1921.

47. WYMAN, L. C., & LUTZ, B. R. The effect of adrenalin on the blood pressure of the elasmobranch, *Squalus scanthias*. *Biol. Bull.*, 1932, **62**, 17-22.

48. YOUNG, J. Z. The Life of Vertebrates. London: Oxford Univ. Press, 1950.

Psychology Department
University of Denver
University Park
Denver 10, Colorado

The Journal of Genetic Psychology, 1963, **102**, 311-324.

CHRONIC EFFECTS OF IONIZING RADIATIONS AND THE HYPOTHESIS THAT IRRADIATION PRODUCES AGING-LIKE CHANGES IN BEHAVIOR*[1]

Department of Psychology, University of South Dakota

Roger T. Davis

A. Introduction

Harlow and his co-workers (12) used problems of delayed response, discrimination and oddity to identify the effects of particular surgical lesions of the association areas of the brains of monkeys. Workers at several laboratories (5, 7, 13, 26) found that performance on these problems varied neither immediately nor within several months after whole-body irradiation with X-rays. Davis and McDowell (6) reported that monkeys which received lethal doses of X-ray irradiation to parts of the head, performed as well on these tasks as nonirradiated *S*s until severe motor disturbances which preceded death made training impossible.

Lesions produced in the CNS by WBR with X-rays, if they occur at all, probably would be diffuse like the lesions produced by natural aging rather than selective as produced by surgical damage to the brain. Therefore it was desirable to draw hypotheses from the literature on the effects of aging as well as the effects of surgical lesions of the brain in order to contrast the behavior of monkeys that have survived radiation and their controls. This strategy was further indicated by parallels between biological effects of aging and radiation (29).

The first experiment was derived from the hypothesis that aged *S*s are more susceptible to the effects of interference in learning than young *S*s (23). The second experiment was based on the finding that old people are more anxious and perform less well than young people under conditions of stress and threat (30). The last experiment compared the ability of irradiated and nonirradiated monkeys to shift set and the design was suggested by differences of old and young human *S*s to shift set (15).

* Received in the Editorial Office on July 13, 1961.

[1] This investigation was supported in part by a research grant (USPH Grant M-2264 C-1) from the National Institute of Mental Health.

B. General Method

1. *Subjects*

Seventeen rhesus monkeys were used as *S*s in these experiments and the experiments were conducted between November 1958 and January 1960. Two groups of *S*s, each comprised of six monkeys aged 8.0 to 9.0 years at the beginning of Experiment I, were employed in all of the experiments, although one *S* in each of these groups died between the end of Experiment II and the beginning of Experiment III. One of the groups, the experimental group, contained survivors of an original group of 10 *S*s, each of which had received 1100 r WBR with X-rays in three doses of 400, 400, and 200 r spaced at yearly intervals. The other groups contained *S*s that were not irradiated and had served as a control group in the radiation studies. The *S*s in both groups had received nearly identical training since 1952. Five young monkeys that were progeny of *S*s in the other two groups comprised a third group. They were given the conditions of Experiment I during Nov. 1959 when they were aged 18 to 42 months and the conditions of Experiment III during January 1960 at the same time as the older *S*s.

2. *Apparatus*

Subjects were trained in a Wisconsin General Test Apparatus (WGTA) in each of the experiments. Stimuli were procured from the collection of common use and manufactured objects at the South Dakota Primate Laboratory, and the sampling of stimuli was specific for each experiment.

C. Experiment I

The first experiment involved giving old irradiated and nonirradiated monkeys and young nonirradiated monkeys concurrent discrimination problems in a modified retroactive inhibition paradigm. Concurrent discrimination problems have been described by Hayes, Thompson, and Hayes (14); and Leary (19) and consist of sets of eight or more object-quality discrimination problems of one trial each, presented sequentially and repeated until *S*s' performance reached some arbitrary criterion.

Several workers have claimed that old human *S*s are more susceptible than young *S*s to the effects of negative transfer, but Gladis and Braun (10) who studied the effects of transfer and retroaction in young and old human *S*s failed to obtain more RI in old than young *S*s. There was, however, more positive transfer between original learning (OL) and interpolated learning (IL) among young than older *S*s.

The retroaction paradigm was modified in the following manner. The *S*s learned one set of concurrent discrimination problems to a criterion of two errorless repetitions of the set during each day of training (OL), learned another set of problems to the same criterion (IL), and relearned the original set (RL). The identity of stimuli employed in OL and IL was varied in order to produce different amounts of associative interference or facilitation. The design resembled that employed by Gladis and Braun (10). They varied the similarity of the meanings of response words, whereas in three of the conditions of the present experiment *S*s made different responses during IL to stimuli employed during OL. In both experiments the control condition was provided by employing completely dissimilar stimuli during IL and OL.

1. *Apparatus and Procedure*

Seven hundred and twenty stimuli were selected from the collection of common use and manufactured objects at the South Dakota Primate Laboratory. Successive pairs of objects were randomly arranged into a fixed serial order and constituted lists which provided *S*s the materials for paired-associates learning by serial recognition.

The lists were presented in a manner similar to that described by Leary (19). A list was given repeatedly to an *S* until it selected the correct object of each pair within the list. A list was learned, OL, a second list learned, IL, and the first list relearned, RL, by an *S* on each of 12 days. Lists consisted of either eight or ten pairs—the shorter lists made available to the young *S*s because of their inability to consume the number of raisin rewards necessary to learn two lists and relearn one list in one session of training.

Four different conditions of similarity of the lists used in IL and OL were presented to *S* during every four days of training and a condition was assigned to a particular day in a predetermined random order. The design was repeated three times.

a. Condition 1 was designed to produce a maximum amount of interference and represented a complete reversal of the rewarded and nonrewarded objects. The objects that were rewarded during IL were the nonrewarded objects from OL and the objects that were not rewarded during IL were the objects that had been rewarded during OL.

b. Under condition 2 the objects used during IL were entirely dissimilar to the objects employed during OL, and *E* expected a minimum amount of interference.

Intermediate similarity was produced in two different conditions because

there is evidence (4, 9) that monkeys with a history of WBR respond differently to objects that are rewarded than do *S*s that have not had a history of irradiation.

c. Under condition 3 the incorrect objects during IL were the objects that had been correct during OL, and the correct objects during IL were unfamiliar to *S*s.

d. Under condition 4 the objects that had been incorrect during OL became the collect objects during IL, and the incorrect objects during IL were unfamiliar to *S*s.

Some *S*s took 30 or more repetitions to learn the two lists and relearn the first list. This procedure represented 300 presentations of pairs of objects and as many possible rewards. In several instances the limit of the rhesus monkey's tolerance of the experimental situation was reached and several *S*s balked. If *S* ceased working, the session was terminated, and the condition was repeated with another set of stimuli.

2. *Design*

The number of repetitions required by each subject in the two groups of old monkeys to learn the two lists was recorded, and differences were compared by means of the *t*-test. Comparisons involving the *S*s in the young group were not made because *S*s in this group learned shorter lists than *S*s in the other two groups.

Analysis of variance was used to evaluate transfer and retroaction effects occurring in learning of the interpolated list and relearning the original list respectively. Preliminary analysis indicated that the differences between the three replications of conditions were not significant, and these data were pooled.

Scores during IL and RL were computed by dividing the average number of repetitions a particular *S* required to meet the criterion of learning under one of the conditions by the average performance on original learning. This procedure equated differences in original learning. The Mann-Whitney *U*-test was employed to test the significance of differences between the performance of *S*s in the three groups under the different conditions.

3. *Results*

Comparison of the two groups of old animals during OL was based on raw scores, i.e., the number of repetitions necessary for *S*s to reach a criterion of one complete errorless rehearsal of the list. Animals in the

experimental group required significantly more repetitions to learn the materials than did the other old *S*s ($t = 5.57$, $p < .01$). Neither group showed significant changes in performance as a function of practice between successive replications of the experiment.

Figure 1 shows the transfer and retroaction effects. A point represents the median score for *S*s in one of the three groups under one of the four conditions of similarity. The horizontal line describes a score of 100. A score above the line indicates facilitation, below the line interference. Transfer is negative between original and interpolated learning under conditions 1, 3, and 4 ($p < .01$, .05 and .05 respectively using the sign test). Condition 1 produces significant retroactive inhibition ($p < .01$) and conditions 2 and 4 significant retroactive facilitation ($p < .05$ and .05). The results of two analyses of variance, one of the transfer data, the other the retroaction data, indicated that the primary effect *conditions* was highly significant in both analyses: $F = 11.22$, $p < .001$ and $F = 21.06$, $p < .001$ respectively. The first order interaction *Groups* $\times$ *Conditions* was significant, $F = 3.35$, $p < .05$, in the second analysis.

Nonparametric tests applied to the data represented by the individual points in the figure show that the groups do not differ significantly under any condition of similarity. However, the figure indicates that the relative amount of facilitation and inhibition in conditions 3 and 4 varies considerably between groups. This tendency was examined statistically by computing the difference between scores of each *S* on conditions 3 and 4, ranking the differences, and using the *U*-test to evaluate the significance of obtaining the values of the summed ranks.

The *S*s in the experimental group exhibited less negative transfer under condition 3 than 4, whereas *S*s in the control group comprised of old *S*s showed more, $U = 5$, $p = .021$ (examine left-hand side of Figure 1). The comparable comparison between *S*s in the experimental group and the control group of young *S*s is also significant, $U = 4$, $p = .026$. A similar difference in performance was found between *S*s in the experimental group and *S*s in the control group of old *S*s when retroaction effects were examined, $U = 4$, $p = .026$ (see right-hand side of the figure).

D. Experiment II

Tinklepaugh's (28) technique of substituting less for more preferred rewards during intratrial delays was used to test the frustrative effects of substituting inferior rewards or eliminating rewards within trials. This

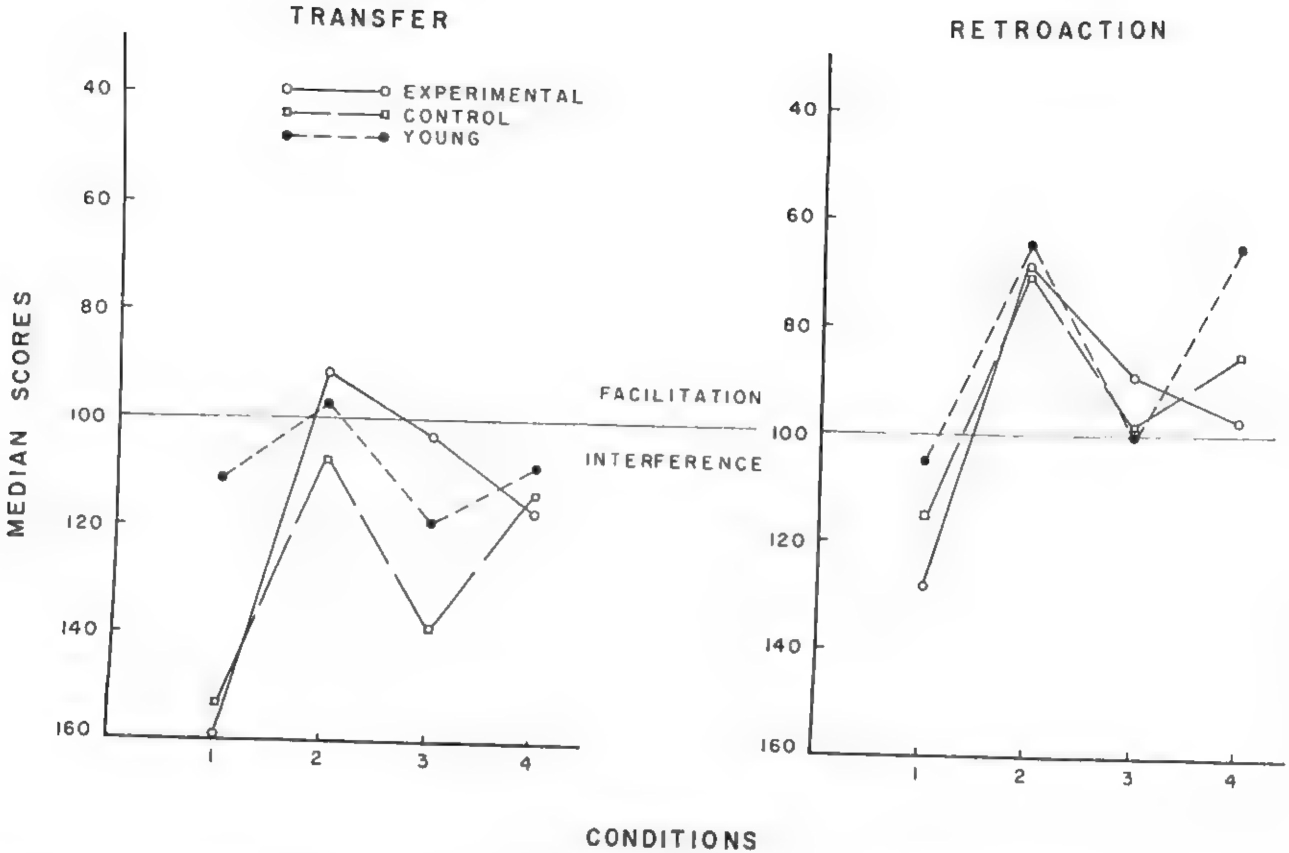

FIGURE 1

Transfer and Retroaction Scores of Three Groups of Rhesus Monkeys on Concurrent Discrimination Problems as a Function of the Similarity of the Original and Interpolated Lists

Condition 1: Rewarded and nonrewarded objects are reversed. *Condition 2:* Objects in IL are dissimilar to objects used in OL. *Condition 3:* Incorrect objects during IL are correct objects during OL. Correct objects during IL are unfamiliar. *Condition 4:* Correct objects during IL are incorrect objects during OL. Incorrect objects during IL are unfamiliar.

procedure was suggested by the finding that old people are more anxious under conditions of threat and stress than young people (30).

1. *Procedure*

The *S*s were trained 24 days, 24 trials a day, on six variations of the delayed response procedure. The first two procedures each occupied six days and provided measures of *S*s' responses to one and to two objects respectively. Delays of 5, 10, or 15 seconds were ordered at random within each day of training. The remaining three procedures of four days each involved baiting one of two foodwells with a raisin and substituting a low preference reward during the delay, e.g., celery or paper wads, or removing the raisin altogether and leaving the trial unrewarded. The substitution or elimination of reward was employed in four different degrees; on every trial, half of the trials, one-fourth of the trials, or one-eighth of the trials and these conditions were randomized between the days of training. The stressfulness of this program is suggested by the fact that every *S* lost weight during the experiment and regained it subsequently.

The objects consisted of steel caps for two inch pipe. The caps were filled with lead and were mounted on 3 × 3 inch squares of Masonite. Each object weighed approximately 3.0 pounds and was painted red.

A trial began with the opaque screen of the WGTA raised and the carrier for the tray at a position near *E*. Trays contained either one centered foodwell or two foodwells 12.0 inches apart. The *E* pushed the carrier forward to a position just out of *S*'s reach, baited one foodwell and covered each foodwell with a stimulus. The opaque screen was lowered and remained down until five seconds had elapsed. If the condition of a trial required the substitution of a less preferred reward for the raisin or the complete elimination of the raisin, *E* made the appropriate change during the delay. The opaque screen was raised, the tray was pushed forward to a stop. When the tray reached the stop it automatically activated a microswitch which started a clock. Microswitches were held closed by the weight of the objects and the circuit containing the clock was opened when *S* displaced one of the objects. The *E* withdrew the tray after *S*'s response, recorded the latency, and prepared the next trial. A noncorrection technique was used throughout.

2. *Results*

Analysis of the results of the first two problems indicated that the latency of *S*'s responses was significantly longer following five-second delays than following either 10- or 20-second delays. Subjects in the group that were old

but not irradiated took significantly longer on 10 and 20 second delayed response problems involving two objects than on comparable problems involving one object, $p < .05$ for both delays using the sign test. The opposite trend was characteristic, but not significantly so, of irradiated *S*s. The *E* also noted casually that the presentation of two objects produced greater vascillation and distraction in the nonirradiated *S*s than the irradiated *S*s.

Analysis of variance was made of the latencies obtained during the last three experimental procedures. This analysis dealt with five primary effects: (*a*) type of stimulus substitution (i.e., raisin, celery, or nothing); (*b*) percentage of substitutions (12.5, 25.0, 50.0 and 100 per cent); (*c*) satiation (trials 1-8, 9-16, and 17-24) within each day of training; (*d*) groups (irradiated and nonirradiated); and (*e*) subjects within groups. Since all *S*s received similar training all variables were orthogonal and formed interactive terms excepting variables d and e which were partially confounded.

Each term that did not involve the effects of groups (d) employed the mean square of the third order interaction which contains the higher number of degrees of freedom ($a \times b \times c \times e$) as the error term. The mean square of each term that involves the effect of groups (d), employs an error term containing *S*s within groups (e) in place of groups. Only two terms are significant, percentage of substitutions (2), $F = 7.127$, $p < .001$; and the second order interaction between percentage of substitutions, satiation and treatment groups (b, c and d), $F = 2.759$, $p < .05$. The former is significant because *S*s take longer to respond when a substitution is made on 100 per cent of the trials. The latter is a complex effect illustrated in Figure 2. It is due to a satiation with practice by all animals under the condition of 100 per cent substitution and by a facilitation of performance in irradiated *S*s under the condition of 25 per cent substitution and nonirradiated *S*s under 12 per cent substitution. The significance of the latter effect was determined by computing, and ranking according to groups of *S*s, the magnitude of the differences in latency between conditions of 12 and 25 per cent substitution, $U = 2$, $p < .004$.

The percentage of errors made on the three conditions of change of reward was 11.7, 9.0 and 8.5 respectively. The difference between these percentages are not significant and this performance does not differ significantly from earlier performance of the same *S*s on 2-object delayed response problems.

E. Experiment III[2]

The third investigation was designed to determine whether monkeys could

[2] Experiment III is abridged from an M.A. thesis by one of the author's students, Daniel W. Swain. Unpublished M.A. thesis, University of South Dakota.

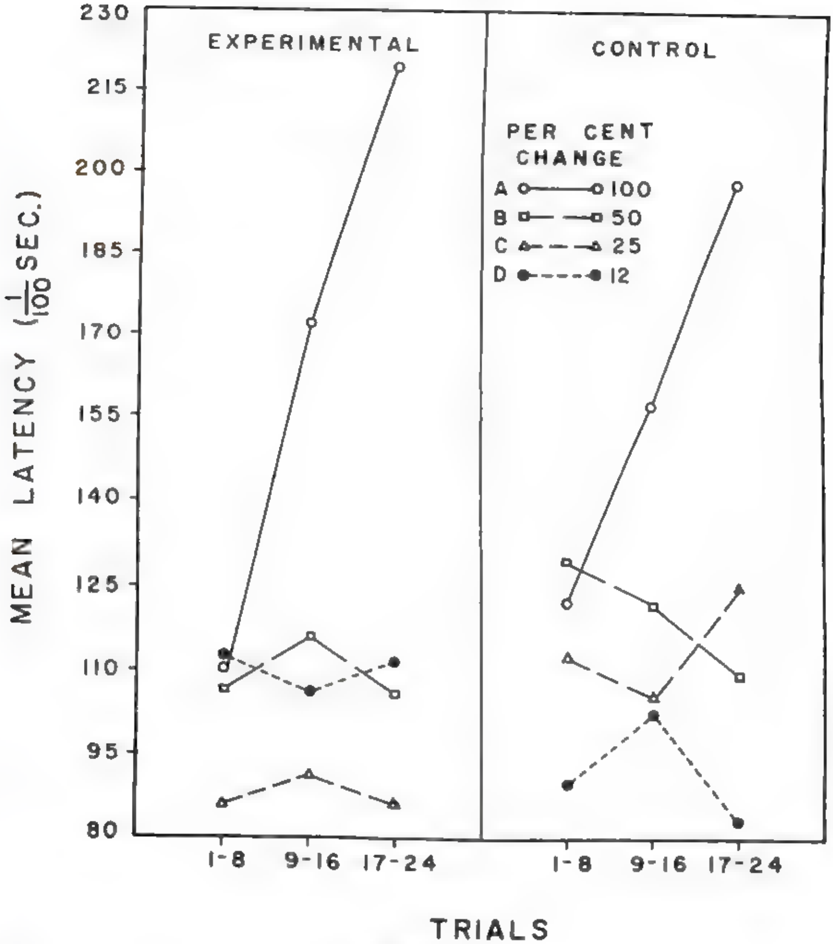

FIGURE 2

Latency of Response of Irradiated and Nonirradiated Monkeys to Delayed Response Problems as a Function of Practice and Per Cent Intratrial Substitution of Less Preferred for More Preferred Reward

learn to shift set, and whether previously irradiated and nonirradiated monkeys could shift with equal facility. Heglin (15) reported that old human *S*s had greater difficulty shifting set than middle-aged *S*s, and young *S*s had less difficulty than middle-aged *S*s. He measured shift of set with alphabet mazes and a variation of the Luchins' Water Jars Test, and reported significant differences between the three age groups in his study. If irradiation produces changes that resemble those in aging the present *S*s should differ in their ability to shift set.

The *S*s were required to shift between problems of discrimination and

double alternation. They had been trained extensively to discriminate prior to the present study.

1. *Apparatus and Procedure*

Each S was given preliminary training and shift of set training during a period of 84 days. A different pair of objects was employed each day of training.

2. *Preliminary Training*

Every S received 72 days of preliminary training on double alternation problems, divided into two periods. During the first 60 days, E presented S a different pair of identical objects each day and rewarded the foodwells according to a double alternation sequence. During the final 12 days of preliminary training dissimilar stimuli were used and the double alternation sequence was employed. During each of the first 45 days of preliminary training the double alternation sequence was repeated four times, i.e., 16 trials. Thereafter the sequence was repeated six times.

3. *Shift of Set Training*

This consisted of 12 days of training similar to that given in the final 12 days of preliminary training except that within each day of training E shifted the appropriate method of problem solving from double alternation to object-quality discrimination and the converse. Trials were divided into three blocks on each day of training with four trials in one block, eight trials in another block and 12 trials in the third block. The order of the three blocks and the order of presenting the two alternative methods of solving the problem were randomized. During the 12 days of training each animal received six days of training in which double alternation (DA) occurred before and after object-quality discrimination training (OQ) and six days in which the order was OQ-DA-OQ.

4. *Design*

The Mann-Whitney U-test was used to evaluate the significance of the differences in errors made between the groups of Ss as they shifted from problems that required them to discriminate between objects to problems entailing a double alternation solution, and the converse shift. Shift of set scores were the percentage of errors for each S during the experimental training period for each block of trials, less the percentage of errors obtained during the last 12 days of preliminary training. This procedure was necessary to equate Ss level of learning attained during preliminary training.

5. *Results*

The young *S*s did not attain a level of performance comparable to that attained by the *S*s of the other two groups during preliminary training. Consequently, only the two older groups of *S*s were compared.

On all three blocks of trials the nonirradiated *S*s had higher shift of set scores when they shifted from discrimination to double alternation problems than did the irradiated *S*s. The two groups of *S*s did not differ significantly on blocks of four trials or 12 trials, $U = 10$, $p = .345$ and $U = 5$, $p = .075$ respectively, but differed significantly on blocks of eight trials, $U = 4$, $p = .048$. The difference between scores obtained on the shift from double alternation to object-quality problems was not significant on any of the three blocks of trials.

F. General Discussion

Within the limits of these experiments only one of the findings in any way support the hypothesis that chronic effects of radiation mimic aging effects. This was the superiority of the performance of *S*s in the control group over the performance of *S*s with a radiation history in original learning of concurrent discrimination problems in Experiment 1. There were, however, several differences between the two groups of old animals not related to the hypothesis drawn from the literature on aging, and all of these differences appear consonant with the body of literature on changes in behavior of monkeys following WBR with X-rays (2, 5, 11, 18, 21, 22). The negative findings of the present experiment together with the negative findings of the effects of irradiation on learning (5, 7, 13, 26) suggest that the syndrome caused by WBR with X-rays is dissimilar both to the syndrome resulting from aging and the syndrome caused by circumscribed lesions of the CNS.

The salient features of the syndrome seen in monkeys that have been irradiated with either whole body or cortical irradiation are motivational and perceptual. The changes that are motivational include immediate and delayed changes in preferences for foods (5, 18) but not changes in the preferences for objects that are not food (1), social responses of aggression and grooming (22), and energy output (20, 22).

The features that are perceptual include the change in ability of irradiated *S*s to employ peripheral cues (2) less distractibility of irradiated *S*s (21), preference of nonirradiated *S*s for environments that allowed exploration of the external environment (11), decrease in relational responses as a function of radiation dose (25), increase in errors among irradiated *S*s when

objects that were unnecessary to solve discriminations were presented (4), increase in the preference of the nonrewarded object as a function of practice if the rewarded object is eliminated (9).

In the first experiment the two groups of old animals responded similarly under conditions of learning interpolated lists of new material and under the condition of reversal of correct and incorrect objects. However, the irradiated and nonirradiated *S*s responded quite differently to conditions 3 and 4 in which the correct and incorrect objects are eliminated respectively. In each of these conditions half of the objects present during OL were discarded before IL. Therefore, *S*s differed in their responses to these conditions because of a difference in the relevance of rewards and nonrewards to irradiated and nonirradiated monkeys. This particular difference was reported recently by Fitzgerald and Davis (9) in another experimental context.

In the second experiment irradiated and nonirradiated monkeys differed significantly on delayed response problems containing one and two objects. The nonirradiated *S*s vascillated more and took significantly longer to respond on two than one object problems whereas the irradiated *S*s performed more efficiently on one than two object problems. This finding resembles McDowell's observation (21) that animals surviving radiation are less distractible than their nonirradiated controls.

The results of the third experiment were in the opposite direction than was predicted from the literature on aging. The nonirradiated old *S*s were less able to shift from object-quality discrimination problems than the old *S*s that had been irradiated. It would appear that the irradiated *S*s were less bound to object cues than the nonirradiated *S*s and more able to shift to position cues. These findings are similar to those of Overall, Brown, and Gentry (25), who reported qualitative differences in the cues used in problem solving.

The findings of the second experiment are also notable because they again illustrate the immutability of the performance of a well-trained rhesus monkey. In spite of severe stress brought on by substitution of less for more preferred foods or the elimination of the reward altogether during the delay, *S*s responded with no more errors than was obtained without stress.

Other experimental examples provide evidence that the correctness or incorrectness of responses of monkeys under conditions of overtraining provide a remarkably stable index of learning that is not liable to variables of motivation. Davis and coworkers (7) reported that monkeys continued to solve problems without decrement in spite of severe radiation sickness and often obtained, then discarded, rewards that were food. Meyer (24) pointed out

that deprivation of food did not affect performance of monkeys on discrimination reversal problems, and Davis (3) showed that errors are not related in a linear fashion to increasing work.

G. Summary

Two groups of old monkeys, one group surviving radiation, the other group nonirradiated, were compared by procedures suggested by three hypotheses from the literature on the changes in behavior accompanying aging.

1. Differences between the groups did not appear to suggest that aging like changes are the chronic consequences of radiation.

2. Differences between the groups all appear to be consonant with earlier findings of the differences of irradiated and nonirradiated monkeys.

References

1. Brown, W. L., Carr, R. M., & Overall, J. E. The effect of whole-body radiation upon association of peripheral cues. School of Aviation Medicine, USAF, Report No. 58-47, 1958.
2. Cho, J. B., & Davis, R. T. Preferences of monkeys for objects other than food. *Amer. J. Psychol.*, 1957, **70**, 87-91.
3. Davis, R. T. Problem-solving behavior of monkeys as a function of work variables. *J. Comp. & Physiol. Psychol.*, 1956, **49**, 499-506.
4. ———. Performance of X-ray irradiated monkeys on discrimination problems with varying numbers of alternatives. *Amer. J. Psychol.*, 1961, **74**, 86-89.
5. Davis, R. T., Elam, C., & McDowell, A. A. Latent effects of chronic whole-body irradiation of monkeys with mixed source radiation. School of Aviation Medicine, USAF, Report No. 57-59, 1958, 1-31.
6. Davis, R. T., & McDowell, A. A. Performance of monkeys before and after irradiation to the head with X-rays. In R. S. Snyder (Ed.), *The Effects of Ionizing Radiation on the Nervous System.* New York: Academic Press, 1960.
7. Davis, R. T., McDowell, A. A., Deter, C. W., & Steele, J. P. Performance of rhesus monkeys on selected laboratory tasks presented before and after a large single dose of whole-body X-radiation. *J. Comp. & Physiol. Psychol.*, 1946, **49**, 20-26.
8. Davis, R. T., McDowell, A. A., Grodsky, M. A., & Steele, J. P. The performance of X-ray irradiated and nonirradiated rhesus monkeys before, during and following chronic barbiturate sedation. *J. Genet. Psychol.*, 1958, **93**, 37-51.
9. Fitzgerald, R. D., & Davis, R. T. The role of reward in the selection of discriminada by naive and sophisticated rhesus monkeys. *J. Genet. Psychol.*, 1960, **97**, 227-235.
10. Gladis, M., & Braun, H. W. Age differences in transfer and retroaction as a function of intertask response similarity. *J. Exper. Psychol.*, 1958, **55**, 25-30.
11. Grodsky, M. A. Preference scales of monkeys using visual and auditory stimuli. Unpublished M. A. thesis, University of South Dakota.
12. Harlow, H. F. Higher functions of the nervous system. *Ann. Rev. Physiol.*, 1953, **55**, 493-514.
13. Harlow, H. F., & Moon, L. E. The effects of repeated doses of total-body X-radiation on motivation and learning in rhesus monkeys. *J. Comp. & Physiol. Psychol.*, 1956, **49**, 60-65.

14. Hayes, K. J., Thompson, R., & Hayes, C. Concurrent discrimination learning in chimpanzees. *J. Comp. & Physiol. Psychol.*, 1953, **46**, 105-107.

15. Heglen, H. J. Problem solving set in different age groups. *J. Geront.*, 1956, **11**, 310-317.

16. Heimstra, N. W., Davis, R. T., & Steele, J. P. Effects of various food deprivation schedules on the discrimination learning performance of monkeys irradiated with X-ray irradiation. *J. of Psychol.*, 1957, **44**, 271-281.

17. Kimeldorf, D. J. Radiation conditioned behavior. In R. S. Snyder (Ed.), *Response of the Nervous System to Ionizing Radiation*. New York: Acadamic Press, 1960.

18. Leary, R. W. Food-preference changes of monkeys subjected to low-level irradiation. *J. Comp. & Physiol. Psychol.*, 1955, **48**, 343-346.

19. ———. The effect of shuffled pairs on the learning of serial discrimination problems by monkeys. *J. Comp. & Physiol. Psychol.*, 1957, **50**, 581-584.

20. Leary, R. W., & Ruch, T. C. Activity, manipulation drive, and strength in monkeys subjected to low-level irradiation. *J. Comp. & Physiol. Psychol.*, 1955, **48**, 336-342.

21. McDowell, A. A. Comparisons of distractibility in irradiated and nonirradiated monkeys. *J. Genet. Psychol.*, 1958, **93**, 63-72.

22. McDowell, A. A., Davis, R. T., & Steele, J. P. Application of systematic direct observational methods to analysis of the radiation syndrome in monkeys. *Percept. & Motor Skills*, 1956, **6**, 117-130.

23. McGoech, J. A., & Irion, A. L. The Psychology of Human Learning. New York: Longmans, Green, 1952.

24. Meyer, D. R. Food deprivation and discrimination reversal learning by monkeys. *J. Exper. Psychol.*, 1951, **41**, 10-16.

25. Overall, J. E., Brown, W. L., & Gentry, G. V. Differential effects of ionizing radiation upon absolute and reliational learning in the rhesus monkey. *J. Genet. Psychol.*, 1960, **97**, 245-250.

26. Riopelle, A. W., Grodsky, M. A., & Ades, H. W. Learned performance of monkeys after single and repeated X-irradiations. *J. Comp. & Physiol. Psychol.*, 1956, **49**, 521-523.

27. Riopelle, A. J., Harlow, H. F., Settlage, P. H., & Ades, H. W. Performance of normal and operated monkeys on visual learning tests. *J. Comp. & Physiol. Psychol.*, 1951, **44**, 283-289.

28. Tinkepaugh, O. L. An experimental study of representative factors in monkeys. *J. Comp. Psychol.*, 1928, **8**, 197-236.

29. Upton, A. C. Ionizing radiation and the aging process. *J. Geront.*, 1957, **12**, 306-313.

30. Welford, A. T. Skill and Age. London: Oxford Univ. Press, 1951.

Department of Psychology
University of Oregon
Eugene, Oregon

The Journal of Genetic Psychology, 1963, **102**, 325-328.

BOOKS

Now that there is a special *APA* journal completely devoted to the publication of book reviews, it is no longer necessary that other journals emphasize such publication. It has always been our conviction that book reviews are a secondary order of publication unless they carry information that is equally important as the book. However, the publication of book titles is a very important service, and we shall continue to render that service.

In any given issue of this journal, we may continue to publish one or more book reviews, but we do not consider such publication a major function of this journal. In line with this policy, we can no longer pay for such manuscripts.

BOOKS RECENTLY PUBLISHED

ALLINSMITH, W., & GOETHALS, G. W. The Role of Schools in Mental Health. New York: Basic Books, 1962. Pp. 337.

ALTSCHUL, A. Aids to Psychology for Nurses. London: Bailliere, Tindall and Cox, 1962. Pp. 308.

AMES, L. B., & ILG, F. L. Mosaic Patterns of American Children. New York: Harper, 1962. Pp. 297.

ARTISS, K. L. Milieu Therapy in Schizophrenia. New York: Grune & Stratton, 1962. Pp. 169.

BACK, K. W. Slums, Projects, and People: Social Psychological Problems of Relocation in Puerto Rico. Durham: Duke Univ. Press, 1962. Pp. 123.

BAKER, G. W., & CHAPMAN, D. W., *Eds.* Man and Society in Disaster. New York: Basic Books, 1962. Pp. 442.

BALL, J. C. Social Deviancy and Adolescent Personality. Lexington: Univ. Kentucky Press, 1962. Pp. 119.

BARRY, R., & WOLF, B. An Epitaph for Vocational Guidance: Myths, Actualities, Implications. New York: Teachers College, Columbia Univ., 1962. Pp. 241.

BAUGHMAN, E. E., & WELSH, G. S. Personality: A Behavioral Science. Englewood Cliffs, N.J.: Prentice-Hall, 1962. Pp. 566.

BERKOWITZ, L. Aggression. New York: McGraw-Hill, 1962. Pp. 361.

BERNDT, R. M. Excess and Restraint. Chicago: Univ. Chicago Press, 1962. Pp. 474.

BIER, W. C., *Ed.* Problems in Addiction: Alcohol and Drug Addiction. New York: Fordham Univ. Press, 1962. Pp. 247.

BRANDEN, N. Who is Ayn Rand? New York: Random House, 1962. Pp. 239.

BREHM, J. W., & COHEN, A. R. Explorations in Cognitive Dissonance. New York: Wiley, 1962. Pp. 334.

BRICKLIN, B., PIOTROWSKI, Z. A., & WAGNER, E. E. The Hand Test: A New Projective Test with Special Reference to the Prediction of Overt Aggressive Behavior. Springfield, Ill.: Thomas, 1962. Pp. 100.

BROAD, C. D. Lectures on Psychical Research. New York: Humanities Press, 1962. Pp. 450.

BROMBERG, W. The Nature of Psychotherapy: A Critique of the Psychotherapeutic Transaction. New York: Grune & Stratton, 1962. Pp. 108.

BROWN, R., GALANTER, E., HESS, E. H., & MANDLER, T. New Directions in Psychology. New York: Holt, Rinehart & Winston, 1962. Pp. 353.

BULL, N. The Body and its Mind: An Introduction to Attitude Psychology. New York: Las Americas Publishing Co., 1962. Pp. 99.

Bullough, G. Mirror of Minds: Changing Psychological Beliefs in English Poetry. Toronto: Univ. Toronto Press, 1962. Pp. 271.

Burke, K. A Grammar of Motives and a Rhetoric of Motives. New York: Meridian Books, 1962. Pp. 868.

Candland, D. K., & Campbell, J. F. Exploring Behavior: An Introduction to Psychology. New York: Basic Books, 1961. Pp. 179.

Clift, V. A., Anderson, A. W., & Hullfish, H. G., *Eds.* Negro Education in America: Its Adequacy Problems, and Needs. New York: Harper, 1962. Pp. 315.

Coser, R. L. Life in the Ward. East Lansing: Michigan State Univ. Press, 1962. Pp. 182.

Crow, L. D., & Crow, A., *Eds.* Readings in Guidance: Principles, Practices, Organization, Administration. New York: McKay, 1962. Pp. 626.

Davis, F. J., Foster, H. H., Jr., Jeffery, C. R., & Davis, E. E. Society and the Law: New Meanings for an Old Profession. New York: Free Press of Glencoe, 1962. Pp. 488.

Davis, K. Human Relations at Work. New York: McGraw-Hill, 1962. Pp. 642.

Deutsch, J. A. The Structural Basis of Behavior. Chicago: Univ. Chicago Press, 1960. Pp. 186.

Duffy, E. Activation and Behavior. New York: Wiley, 1962. Pp. 384.

Duvall, E. M. Family Development: Second Edition. Philadelphia: Lippincott, 1962. Pp. 532.

Ellis, A. The American Sexual Tragedy: Rev. Ed. New York: Stuart, 1962. Pp. 320.

Eriksen, C. W., *Ed.* Behavior and Awareness: A Symposium of Research and Interpretation. Durham: Duke Univ. Press, 1962. Pp. 158.

Estabrooks, G. H., *Ed.* Hypnosis: Current Problems. New York: Harper & Row, 1962. Pp. 285.

Feibleman, J. K. Biosocial Factors in Mental Illness. Springfield, Ill.: Thomas, 1962. Pp. 111.

Feigl, H., & Maxwell, G., *Eds.* Scientific Explanation, Space, and Time, Vol. III. Minneapolis: Univ. Minnesota Press, 1962. Pp. 628.

Fleming, C. M. Adolescence: Its Social Psychology. New York: Grove Press, 1962. Pp. 262.

Friedman, L. J. Virgin Wives: A Study of Unconsummated Marriages. Springfield, Ill.: Thomas, 1962. Pp. 161.

Gendlin, E. T. Experiencing and the Creation of Meaning: A Philosophical Approach to the Subjective. New York: Free Press of Glencoe, 1962. Pp. 302.

Gerberich, J. R., Green, H. A., & Jorgensen, A. N. Measurement and Evaluation in the Modern School. New York: McKay, 1962. Pp. 622.

Glaser, R., *Ed.* Training Research and Education. Pittsburgh: Univ. Pittsburgh Press, 1962. Pp. 596.

Glick, I. O., & Levy, S. J. Living with Television. Chicago: Aldine, 1962. Pp. 262.

Glueck, S., & Glueck, E. Family Environment and Delinquency. Boston: Houghton Mifflin, 1962. Pp. 328.

Goody, J. Death, Property and the Ancestors. Stanford: Stanford Univ. Press, 1962. Pp. 452.

Green, E. J. The Learning Process and Programmed Instruction. New York: Holt, Rinehart & Winston, 1962. Pp. 228.

Haefele, J. W. Creativity and Innovation. New York: Reinhold, 1962. Pp. 306.

Hare, A. P. Handbook of Small Group Research. New York: Free Press of Glencoe, 1962. Pp. 512.

Harrison, J. E. Epilegomena to the Study of Greek Religion and Themis. New Hyde Park, N.Y.: University Books, 1962. Pp. 600.

Herbert, W. L., & Jarvis, F. V. Dealing with Delinquents. New York: Emerson Books, 1962. Pp. 208.

Hirt, M., *Ed.* Rorschach Science. New York: Free Press of Glencoe, 1962. Pp. 438.

Hughes, E. J., *Ed.* Education in World Perspective: The International Conference on World Educational Problems. New York: Harper & Row, 1962. Pp. 201.

JOHNSON, W. L., & HARDIN, C. A. Content and Dynamics of Home Visits of Public Health Nurses: Part I. New York: American Nurses' Foundation, 1962. Pp. 146.
KESSEN, W., & KUHLMAN, C., *Eds.* Thought in the Young Child. Lafayette, Ind.: Society for Research in Child Development, 1962. Pp. 176.
KING, S. H. Perceptions of Illness and Medical Practice. New York: Russell Sage, 1962. Pp. 405.
KIRK, S. A. Educating Exceptional Children. Boston: Houghton Mifflin, 1962. Pp. 413.
KLOPFER, B., & DAVIDSON, H. H. The Rorschach Technique: An Introductory Manual. New York: Harcourt, Brace & World, 1962. Pp. 245.
KLOPFER, P. H. Behavioral Aspects of Ecology. Englewood Cliffs, N.J.: Prentice-Hall, 1962. Pp. 166.
KRAKOWSKI, A. J., & SANTORA, D. A., *Eds.* Child Psychiatry and the General Practitioner. Springfield, Ill.: Thomas, 1962. Pp. 190.
LANE, R. E. Political Ideology. New York: Free Press of Glencoe, 1962. Pp. 509.
McGOWAN, J. F. & SCHMIDT, L. D. Counseling: Readings in Theory and Practice. New York: Holt, Rinehart & Winston, 1962. Pp. 623.
McNEMAR, Q. Psychological Statistics: Third Edition. New York: Wiley, 1962. Pp. 451.
MADIGAN, M. E. Psychology: Principles and Applications. St. Louis: Mosby, 1962. Pp. 379.
MARROW, A. J. Changing Patterns of Prejudice. Philadelphia: Chilton Books, 1962. Pp. 271.
MARTIN, B. R. Communicative Aids for the Adult Aphasic. Springfield, Ill.: Thomas, 1962. Pp. 70.
MEERLOO, J. A. M. Suicide and Mass Suicide. New York: Grune & Stratton, 1962. Pp. 153.
MERENESS, D. & KARNOSH, L. J. Essentials of Psychiatric Nursing. St. Louis: Mosby, 1962. Pp. 312.
MERLEAU-PONTY, M. Phenomenology of Perception. New York: Humanities Press, 1962. Pp. 466.
MEYNARD, B. The Nature of Ego: A Study. New York: Philosophical Library, 1962. Pp. 211.
MILLER, G. A. Psychology. New York: Harper & Row, 1962. Pp. 388.
MUNN, N. L. Introduction to Psychology. Boston: Houghton Mifflin, 1962. Pp. 588.
OSWALD, I. Sleeping and Waking: Physiology and Psychology. New York: American Elsevier, 1962. Pp. 232.
PARKER, B. My Language Is Me. New York: Basic Books, 1962. Pp. 397.
PARNES, S. J., & HARDING, H. F., *Eds.* A Source Book for Creative Thinking. New York: Scribner's, 1962. Pp. 393.
PFEIFFER, J. The Thinking Machine. Philadelphia: Lippincott, 1962. Pp. 242.
POSTMAN, L., *Ed.* Psychology in the Making. New York: Knopf, 1962. Pp. 785.
POSTON, R. W. Democracy Speaks Many Tongues. New York: Harper, 1962. Pp. 206.
POWDERMAKER, H. Copper Town. New York: Harper, 1962. Pp. 391.
QUEVADO, F. The Scavenger. New York: Las Americas, 1962. Pp. 146.
RADO, S. Psychoanalysis of Behavior. New York: Grune & Stratton, 1962. Pp. 196.
REIK, T. Jewish Wit. New York: Gamut Press, 1962. Pp. 246.
RIESE, H. Heal the Hurt Child. Chicago: Univ. Chicago Press, 1962. Pp. 615.
SALZMAN, L. Developments in Psychoanalysis. New York: Grune & Stratton, 1962. Pp. 302.
SARNOFF, I. Personality Dynamics and Development. New York: Wiley, 1962. Pp. 572.
SARTORI, G. Democratic Theory. Detroit: Wayne State Univ. Press, 1962. Pp. 497.
SCHAEFER, K. E., *Ed.* Environmental Effects on Consciousness. New York: Macmillan, 1962. Pp. 146.
SCHNEIDER, N. Hypnotism and You. New York: Exposition Press, 1962. Pp. 77.
SHERIF, M., *Ed.* Intergroup Relations and Leadership. New York: Wiley, 1962. Pp. 284.

SIEGEL, B. J., *Ed.* Biennial Review of Anthropology, 1961. Stanford: Stanford Univ. Press, 1962. Pp. 338.

SIEGEL, L. Industrial Psychology. Homewood, Ill.: Richard D. Irwin, 1962. Pp. 414.

SIMMONS, J. R. The Quest for Ethics. New York: Philosophical Library, 1962. Pp. 54.

SUDRE, R. Para-Psychology. New York: Grove Press, 1962. Pp. 412.

TALLENT, N. Clinical Psychological Consultation. Englewood Cliffs, N.J.: Prentice-Hall, 1963. Pp. 298.

WELLS, M. J. Brain and Behaviour in Cephalopods. Stanford: Stanford Univ. Press, 1962. Pp. 171.

YABLONSKY, L. The Violent Gang. New York: Macmillan, 1962. Pp. 264.

YATES, A. J. Frustration and Conflict. New York: Wiley, 1962. Pp. 236.